

EARTHWORMS (OLIGOCHAETA: MEGASCOLECIDAE) FROM SOUTH AUSTRALIA

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Summary

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The Megascolecidae is the only family of earthworms indigenous in South Australia. The megascolecid fauna of the state is impoverished, though specific endemicity is high, consisting of five genera with thirteen species. These are the circum-mundane *Microscolex dubius* (Fletcher, 1888a); the new endemic species *Perionychella* (P.) *inconstans*, *Spenceriella imparicystis*, *S. penolaensis*, *Gemascolex bursatus*, *G. mirabilis*, *G. octothecatus*, *G. similis*, and *G. walkeri* spp. nov.; the previously known endemic species *G. newmani* Edmonds & Jamieson, 1973, and *G. stirlingi* (Fletcher, 1888a); and two species known also from Victoria, *G. lateralis* (Spencer, 1892; syn. *Megascolex zeitzi* Michaelsen, 1907b) and *Heteroprorodrilus shephardi* (Spencer, 1900), the latter being represented by the new subspecies *H. shephardi armatus*. In sharing its four indigenous genera and two of its species with Victoria, South Australia shows close zoogeographic affinities with this state whereas affinities with Western Australia are minimal, consisting only of a close relationship between *Perionychella* and the Western Australian genus *Graliophilus*. The paucity of the fauna is attributed to the low rainfall and it is noted that ten of South Australia's thirteen species have excretory adaptations, in the form of intestinal enteronephry, which favour water conservation.

Introduction

Three indigenous species of earthworms (Family Megascolecidae) have previously been recorded from South Australia. All were assigned to a single genus, *Gemascolex* by Edmonds & Jamieson (1973). The three species are *G. stirlingi* (Fletcher, 1888a) of which *Megascolex fletcheri* Shannon (1920) is a junior synonym; *G. zeitzi* (Michaelsen 1907b) which (see below) is a junior synonym of *G. lateralis* (Spencer, 1892); and *G. newmani* Edmonds & Jamieson, the type-species of *Gemascolex*. The only other megascolecid earthworm previously recorded from the state is *Microscolex dubius* (Fletcher, 1888a), for which Adelaide is a type-locality. This species is euryhaline and is circum-mundane in warmer, though not tropical, regions. Its centre of origin is unknown.

The only other earthworms from South Australia belong to the holarctic family Lumbricidae. This non-indigenous family is beyond the scope of this work. It is nevertheless of interest to note localities from which lumbrici-

cids were obtained in the present survey and these are included in the map (Fig. 1).

With the assistance of Mr. T. Walker, the author collected earthworms in August 1972, after favourable rains, from 26 localities (see Fig. 1), from Mt. Remarkable in the north to the Fleurieu Peninsula in the south. Collecting yielded twelve species of Megascolecidae, including the three previously described *Gemascolex* spp. and *Microscolex dubius*. A further species, collected by Mr. Ifor Thomas from Kangaroo Island, brings the total of known megascolecid species from the state to 13. No collection was done on Yorke and Eyre Peninsulas in the west, nor in much of the wetter south-eastern portion of the state, and it seems likely that further species will be found in those areas. It is hoped that this study will stimulate others to make the further collections necessary to yield a definitive checklist of South Australian earthworms.

Systematics

The megascolecid species of South Australia fall into the subfamilies Acanthodrilinae, rep-

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represented by the tribe Acanthodrilini, and Megascolecinae, represented by the tribes Perionychini and Megascolecini sensu Jamieson, 1971a. The sub-families and tribes are set out in this order in the present account and the species are listed in alphabetical order under their genera within each tribe. Abbreviations for institutions in which specimens have been lodged are: AM (Australian Museum, Sydney), BJ (Author's collections), BM (British Museum (Natural History)) and SAM (South Australian Museum). The major collectors, B. G. M. Jamieson and T. Walker, are indicated by the initials B.J. and T.W., respectively. The abbreviation H signifies holotype and P paratype. Explanations of terminology used in descriptions may be found in Michaelsen (1900), Stephenson (1930) and (nephridia) in Jamieson (1971a).

A key to the Megascolecidae of South Australia follows. To permit ready identification, without necessitating detailed study of the excretory system which is the basis for tribal classification, tribes have been omitted and the key proceeds directly to species. As unknown species may be encountered by collectors, agreement with illustrations cited in the key is

required, and the detailed descriptions should be checked to confirm identification.

Family MEGASCOLECIDAE

Subfamily ACANTHODRILINAE s. Jamieson, 1971a

Tribe ACANTHODRILINI s. Jamieson, 1971a

Holonephric, or, if wholly or partly meronephric, with a single pair of prostates. Prostates tubular, one to three pairs. Stomate meronephridia, where present, not forming a series median to astomate micromeronephridia.

Genus MICROSCOLEX Rosa, 1887

Microscolex dubius (Fletcher, 1888a), Rosa, 1890: 511. Michaelsen, 1907a: 146-148; 1907b; 5. Pickford, 1937: 429-432, figs 398-399. Gates, 1962: 7-15.

FIGS 2A, 12; TABLE 1

Eudrilus (?) *dubius* Fletcher, 1888a: 378-381.

Length = 36 mm, w (midclitellar) = 3.4 mm, s = 88 (specimen 1). Circular in cross section. Pigmentless in alcohol. Prostomium not canaliculate, epilobous 1/2, closed. Peristomium not bisected ventrally. Dorsal pores absent. Setae 8 per segment, commencing in II, in regular longitudinal rows throughout. Setae a and h absent in XVII.

Key to the megascolecid species of South Australia

1. Combined male and prostatic pores a pair on XVII (16th setigerous segment). Spermathecal pores absent *Microscolex dubius*, Fig. 2A
1. Combined male and prostatic pores a pair on XVIII (17th setigerous segment). Spermathecal pores present 2
2. Nephridia one pair per segment 3
2. Nephridia several to many in a segment 4
3. Nephridia with terminal bladders which alternate from lateral to ventral *Heteropodrilus shephardi armatus*, Fig. 2B
3. Nephridia without bladders; ducts in a single series on each side *Perionychella* (P.) *inconstans*, Fig. 6C
4. Calciferous glands present on the oesophagus, paired in X, XI-XIII 5
4. Calciferous glands absent 6
5. Calciferous glands 4 pairs, in X-XIII. Spermathecae unpaired *Spenceriella imparicystis*, Fig. 9A
5. Calciferous glands 3 pairs, in XI-XIII. Spermathecae paired *Spenceriella penolaensis*, Fig. 9B
6. Spermathecal pores 1 pair, in 5/6 *Gemascolex walkeri*, Fig. 7A
6. Spermathecal pores more than 1 pair, in 7/8 or 8/9 anteriorly 7
7. Spermathecal pores 2 pairs 8
7. Spermathecal pores more than 2 pairs 9
8. Last spermathecal pores in 7/8 *Gemascolex mirabilis*, Fig. 5
8. Last spermathecal pores in 8/9 *Gemascolex hirsutus*, Fig. 3A
9. Spermathecal pores 4 pairs *Gemascolex octothecus*, Fig. 6A, B
9. Spermathecal pores 3 pairs 10
10. Last hearts in XII *Gemascolex lateralis*, Fig. 4A, B
10. Last hearts in XIII 11
11. Genital marking(s) unpaired, midventral *Gemascolex newmani*, Fig. 7B
11. Genital markings paired 12
12. Male pores about one third of the body circumference apart. No genital markings present behind them *Gemascolex similis*, Fig. 3B
12. Male pores about one fifth of the body circumference apart. Paired genital markings behind them *Gemascolex stirlingi*, Fig. 8A, B

TABLE 1

Interval distances in *Microscolex dubius*

	aa	ab	bc	cd	dd	de	eb	ba
Segment XII	0.0	0.6	1.3	1.0	2.2	1.0	1.3	0.6
Segment XX	1.1	0.5	1.5	1.1	3.3	1.0	1.7	0.5
	standardised as % of circumference							
Segment XII	aa	ab	bc	cd	dd	de	eb	ba
Segment XX	10.0	6.5	14.8	10.8	24.3	11.6	14.4	6.8
Mean	11.3	5.1	15.3	11.7	27.7	10.2	17.5	5.1
Interval/ab	10.7	5.0	15.1	11.2	26.3	10.9	16.0	6.9
Interval/ab	1.6	1.0	2.5	1.9	4.1	1.8	2.7	1.0

Nephropores inconspicuous, in the intersegmental furrows a little less than $1/3$ bc below a ; first observed at 6/7. Clitellum annular. XII–XVI with weak development through XVII, well developed but not strongly protuberant, apparent as a smooth region owing to suppression of intersegmental furrows 14/15 and 15/16; setae and nephropores retained. Male pores minute, equatorial in XVII, lateral of setal lines a , each in an oval field, which is not sufficiently elevated to be termed a porophore, the pores 1.26 mm, 0.14 circumference, apart. Accessory genital markings absent. Female pores paired, almost at the anterior margin of XIV, shortly median of a lines. Spermathecal pores absent.

Strongest septa 8/9–13/14, moderately strong. Dorsal blood vessel single, continuous onto the pharynx. Last hearts in XII, those in X–XII latero-oesophageal, each with a connective from the dorsal and from the poorly distinguishable supra-oesophageal vessel; the latter oesophageal only. Commissurals in VI–IX dorsoventral only. Subneural vessel absent. Gizzard rudimentary, in V. Oesophagus thicker walled and more rugose internally in X–XIV than anteriorly, moniliform throughout though narrower in XV. Extramural calciferous glands absent. Intestinal origin XVI; typhlosole, caeca and muscular thickening absent. Nephridia stomate, vesiculate holonephridia; those in II–IV each sending a duct laterally to discharge presetally in d line, the duct in II avesculate, the ducts in III and IV each with a small subspherical bladder; the nephridia in V discharging through small subspherical somewhat crenulated bladders presetally immediately below c lines, the bladders joined medianly and slightly subterminally by the ducts; by segment VIII the duct median to the bladder is itself swollen and by XII the original bladder protrudes from the lateral aspect of the wedge shaped expansion of the duct and may be considered a short rounded diverticulum; the bladders reach their furthest separation from c line, at approximately one fourth eb , in the

vicinity of XVII and maintain this position further posteriorly. Caudally the diverticulum becomes a definite lateral caecum, about twice as long as wide, though hidden by coils of the nephridium. Holandric, clavate testes and non-iridescent funnels in X and XI; seminal vesicles 2 pairs, racemose, in XI and XII. Metagynous; ovaries, flattened lobes with several conjoined strings of large oocytes, and funnels in XIII; small ovisacs in XIV. Prostates almost straight, tubular, passing laterally from the ducts in XVII and widening evenly to the rounded free extremity so as to appear slenderly clavate; the external duct indistinctly demarcated but with a slight muscular sheen; the double vas deferens joining the duct at its ental third. Perit setae present in two follicles, a and b , the b follicle entering the body wall in common with the prostate duct. Each perisetal follicle with two functional and two reserve setae; each seta almost straight, ectally tapering slightly to a blunt point, the ectal fifth bearing a longitudinal series of approximately 7 to 10 circumferential sets of short transverse incisions; the posterior border of each incision forming a few minute anteriorly directed denticles; the incisions in a set arranged obliquely around the circumference of the seta; this ornamentation poorly visible under the light microscope; lengths of two functional setae 0.52 and 0.72 mm, general width of the shaft 16 μ m and 26 μ m respectively. Spermathecae absent.

Material examined: Lm1, 140°55'E, 38°01'S, 26 km from Mt. Ganibier along road to Nelson, in sandy loam under grass among wattles and gums and some garden escapes. B.J. and T.W., 15.viii.1972—2 specimens (BJ).

Type-locality: Sydney, Mulwala (N.S.W.): Adelaide.

Other Australian localities: Tas. (Jude Michaelsen 1900); N.S.W.—Newcastle, Paramatta (Michaelsen 1907a, b); Jenolan Caves area (Boardman 1943), South western Australia (Michaelsen 1907a), Qld—Toowoomba (Stephenson 1933), A.C.T. (Gates 1962).

Remarks: *Microscolex dubius* is a euryhaline species circum-mundane in the northern and southern hemispheres mostly in warmer regions, though not tropical.

Absence of spermathecal pores, location of combined male and prostatic pores on XVII and progressive narrowing of setal interval ab in an anterior direction from approximately

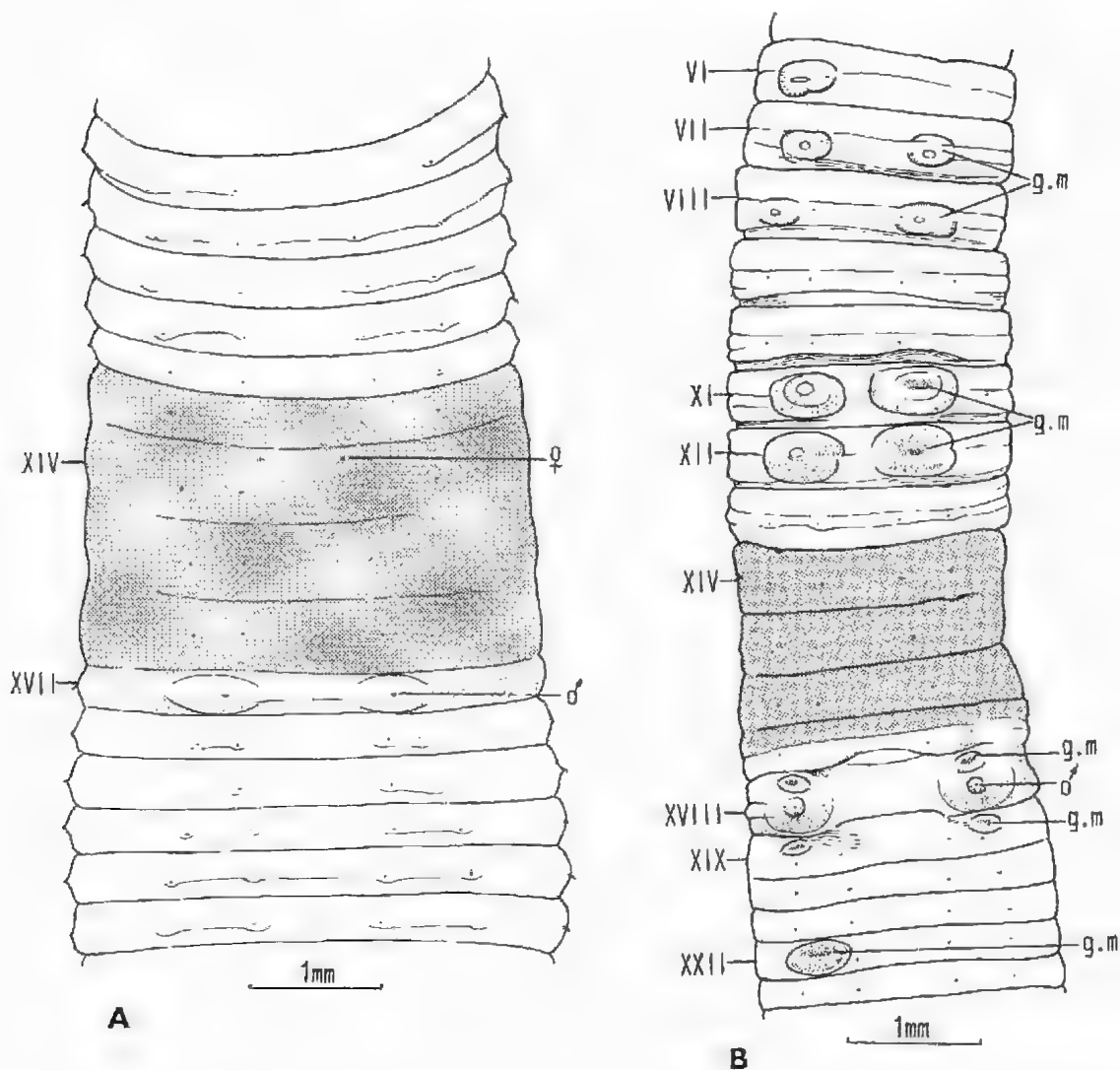


Fig. 2. Genital fields of: A, *Microscolex dubius*, specimen 1, Lm1. B, *Heteroporodrilus shephardi armatus*, holotype, L11.

Symbols used in illustrations of genital fields: ♀, female pore; g.m., accessory genital marking; ♂, male pore; sp.p., spermathecal pore, Roman numerals are segment numbers. Clitellum shaded. All by camera lucida.

segment XXII to XVIII allow ready recognition of this species.

Subfamily MEGASCOLECINAE s. Jamieson, 1971a

Tribe PERIONYCHINI s. Jamieson, 1971a

Male and prostatic pores coincident or (*Diplotréma* part, New Caledonia) near together on XVIII; sometimes with a single median combined male and prostatic pore.

Prostates one pair, tubular to racemose. Purely holonephric, or with meronephridia in a varying number of segments anterior to holonephridia; never (?) with intestinal enteronephry.

Genus PERIONYCHELLA Michaelsen, 1907a

Perionychella (P.) *inconstans* sp. nov.

FIGS 6C, 10A; TABLE 2

Length = 63(H)–77(P1) mm, w (mid-clitellar) = 2 mm, s = 122(H)–131(P1). Pigmentless in alcohol with the exception of the reddish brown clitellum. Form attenuated; circular in cross section. Prostomium epilobous 2/3, acute, closed; not canaliculate. Peristomium not bisected ventrally. Setae 8 per segment, in regular longitudinal rows throughout (H) or *c* and *d* irregular posteriorly (P1); *a* and *b* absent in XVIII.

Nephropores sporadically visible, on and behind the clitellum, anteriorly in their segments in *h* lines. Clitellum annular, very conspicuous owing to strong tumescence and its reddish color (almost fusiform and reminiscent of that of the aquatic genus *Sparganophilus*), clearly demarcated in XIII–2/3 XVIII, but some clitellar modification and pinkish pigmentation present throughout XII and XVIII dorsally, i.e. extent XII–XVIII (= 7 segments); intersegments 13/14–17/18 totally obliterated dorsally. Male pores equatorial in *a* lines of XVIII on strongly protuberant, subcircular papillae which fill all but a small anterior part of the segment, the lateral borders of the papillae less clearly demarcated than the median borders. The papillae lie in a whitish glandular field which interrupts the clitellum from shortly presetally in XVII, laterally beyond *b* in XVII and XVIII, and which extends posteriorly to include (H) or just precede (P1) the setal arc of XX. The setal annulus of XVII to shortly lateral of *b* forms a transverse ventral ridge. Distinct accessory genital markings are not recognizable in the male field but there is a suggestion of a transverse pad from mid *ab* to lateral of *b* on each side filling the anterior third of XVIII. An unpaired, midventral, circular accessory genital marking with depressed central area and porelike centre almost fills the length of each of segments VII, VIII and IX and extends laterally to *a* or into *ab* (H, P1; see Field Variation). Female pores paired, shortly anterior to (H) or anteromedian (P1) to setae *a* of XIV, in a common glandular field which fills *bb* and longitudinally extends from 13/14 posteriorly to just include the ventral setal couples. Spermathecal pores in 7/8 and 8/9, each on an inconspicuous papilla almost concealed in the intersegment, unpaired midventral (P1) or paired immediately median to *a* lines (H).

Thickest septa 7/8–9/10, moderately strongly thickened (H, P1). Dorsal blood vessel single, continuous onto the pharynx (H). Last hearts in XIII, those in X–XIII latero-

TABLE 2
Inter-setal distances in Perionychella (P.) inconstans

	mm							
	aa	ab	bc	cd	dd	de	eb	ba
Segment XII								
Holotype	0.5	0.2	0.5	0.4	2.4	0.3	0.5	0.1
Paratype 1	0.3	0.2	0.4	0.3	2.1	0.3	0.4	0.2
Segment XX								
Holotype	0.4	0.2	0.5	0.3	2.0	0.3	0.5	0.2
Paratype 1	0.5	0.2	0.5	0.3	2.0	0.3	0.4	0.2
	standardized as % of circumference							
	aa	ab	bc	cd	dd	de	eb	ba
Segment XII								
Holotype	10.6	4.1	10.0	7.1	46.6	6.5	9.8	4.9
Paratype 1	7.7	5.4	9.1	6.3	49.8	7.7	9.8	4.9
Mean	9.1	4.7	9.8	6.7	48.2	7.1	9.8	4.9
Interval/ab	1.9	1.0	2.1	1.4	10.2	1.3	2.1	1.0
Segment XX								
Holotype	9.7	4.9	10.6	7.8	46.4	6.7	10.7	4.2
Paratype 1	9.9	5.0	10.9	6.4	47.2	5.9	9.0	5.0
Mean	9.8	4.9	11.2	7.1	46.8	6.3	9.8	4.6
Interval/ab	2.0	1.0	2.3	1.2	9.5	1.3	2.0	0.9

oesophageal, each receiving a connective from the dorsal vessel and from the supra-oesophageal vessel. The latter vessel extends from 1/2 VIII–XIV (P1), 1/2 XV (H) and except at its extremities, is larger than the dorsal vessel. No subneural vessel detectable.

Gizzard small and globose in V, its posterior limit being at 1/2 VI; muscular but easily compressed. Oesophagus moniliform but not evidently vascularized in VI–VIII, in IX–XIV moniliform and apparently with increased vascularization (especially vascular in IX), in XV–XVII (H)–XIX (P1) tubular and only slightly vascularized, in XVIII (H) similar to that in XVII but globose. Intestinal origin apparently XIX where the wall is thinner (H) or XX (P1, with oesophageal valve at 19/20), not reaching full width until XXI; typhlosole absent, though a rudimentary mid-dorsal ridge is observable in paratype 1, muscular thickening and caeca absent (H, P1). Nephridia holonephridia first recognizable in XI (P1) or XIII (H) but 2 pairs of small tuftlike structures on the body wall, in IV and V (P1) may be tufted nephridia (the extreme narrowness of the worm rendering dissection very difficult); each holonephridium with a large pre-septal funnel and narrow duct discharging presetally in *h* line.

Holandric, testes and iridescent funnels in X and XI; seminal vesicles large, racemose, with many large discrete loculi, in IX and XII. Metagynous (ovaries consisting of a few irregular chains of very large oocytes and funnels in XIII); true ovisacs, each with several very large oocytes, in XIV. Prostates a pair of thick short tortuous tubes restricted to XVIII (P1) or their ental ends just entering XIX (H); muscular ducts straight or slightly curved, not sinuous. Penial setae present, their

follicles extending from XVIII into XX, fill-form.

Spermathecae in VII and IX, each with a saciform, narrow-stalked ampulla and a digitiform-clavate (inseminated) sinuous diverticulum joining the base of the duct and longer than duct plus ampulla. In paratype 1 there is only a single spermatheca in each segment, its duct entering the body wall below the ventral nerve cord. In the holotype there are 2 spermathecae in each segment, discharging median to *a* lines, and the right spermatheca in each segment has a replicated ampulla.

Field variation: The male genital field has the form described for the holotype in the 9 specimens selected as paratypes but the right prostate (and male porophore) is replicated in paratype 4 so that there is one in XVIII and a further one in XIX. Midventral unpaired accessory genital markings are present in VII, VIII and IX in 3 specimens (including the holotype), in VII and VIII, in 3 specimens, and in VIII and IX in 4 specimens. Spermathecal pores, in 7/8 and 8/9, are paired shortly median of *a* lines in 5 specimens, paired but ventrally almost contiguous in 1 specimen, and are unpaired, midventral, in 3 specimens, being externally unrecognizable in the remaining specimen.

Material examined: HJ1, 136°44'E, 35°56'S, in soft, waterlogged earth, bonded with grass and grass roots, on the banks of Rocky River, about 1.6 km N of Rocky River Homestead, Kangaroo I.; approximately 50 worms per square foot, *f. Thomas*, date?—H, P1–9 (plus many additional specimens), H, P2–4 (AM); P1, 5, 6 (BM); P7 (SAM); P8, 9 and additional specimens (BJ).

Remarks: This species differs from others in *Perionychella* in location of nephropores in *b* lines and in that *cd* is not as large relative to *ab*. These differences may indicate that it is phylogenetically distinct from the remainder of the genus but erection of a separate genus for its reception does not appear necessary.

Genus *HETEROPORODRILUS* Jamieson, 1970

Heteroporodrilus shephardi (Spencer, 1900)
armatus subsp. nov.

FIGS 2B, 10B, 11A, 13; TABLE 3

Length = 113+(H) mm–132(P1) mm, w (midclitellar) = 7(P1)–8(H) mm, s = 109+(H, posterior amputee; P1 damaged). Form angular in cross section the periphery being

straight between adjacent setal lines. Pigmented greyish brown but pale ventrally in alcohol. Prostomium protanylobous, with a transverse furrow at O/1 (H) or epitanylobous with a transverse furrow at $\frac{1}{2}$ l; the peristomium with several longitudinal furrows so that extension of a dorsal prostomial tongue to 1/2 is questionable. Canalicula absent. First dorsal pore 6/7 (H, P1). Setae 8 per segment, in regular longitudinal rows throughout; setae *a* and *b* absent, replaced by penial setae, in XVIII.

Nephropores conspicuous, anterior in their segments in the holotype in II(?), III–IV in *d* lines; in V–IX alternating from *d* to mid *bc* (commencing in V in *d* on the right and mid *bc* on the left); thereafter alternating from *d* to *b* (in X in *b* on the right and *d* on the left); the nephropores symmetrically disposed in paratype 1: in II–IV in *d* lines; in V and VI in mid *bc*; in VII–IX alternating from *d* to mid *bc*; in X backwards alternating from *b* to *d* (examined in H and P1 to 20/21). Clitellum annular, XIV–1/3 XVII; dorsal pores occluded in 14/15–16/17; intersegmental furrows fainter dorsally; setae and nephropores clearly visible. Male pores on XVIII in *b*, each on a slender papilla strongly protuberant from an indistinct low circular prominence. Accessory genital markings: transverse oval to oblong pads with porelike centres in VI (unilateral, right), VII and VIII (paired) filling *ab* and with centres at or slightly behind the setal arc; similar but larger pads almost filling the segments longitudinally and with centres immediately presetal in *ab* paired in XI and XII and unilateral, right, in XXII; paired deep pits in *ab* in 17/18 and immediately behind

TABLE 3

Intersetal distances in Heteroporodrilus shephardi armatus

	mm							
	du	ab	bc	cd	dd	de	cb	ba
Segment XII								
Holotype	2.6	2.1	3.3	3.8	6.8	3.6	3.1	1.9
Paratype 2	2.3	1.4	2.2	2.4	4.4	2.4	2.2	1.2
Paratype 3	1.9	1.5	2.3	2.6	5.4	2.5	2.2	1.5
Segment XX								
Holotype	3.0	1.6	2.9	3.9	6.2	3.7	2.9	1.5
Paratype 2	2.3	1.2	1.8	2.9	4.4	3.1	2.2	1.4
Paratype 3	1.9	1.3	2.4	2.4	5.2	2.4	2.4	1.1
standardized as % of circumference								
	du	ab	bc	cd	dd	de	cb	ba
Segment XII								
Holotype	9.6	7.8	12.1	14.0	25.0	11.3	11.4	7.0
Paratype 2	12.1	7.4	11.6	12.6	23.1	12.6	11.6	9.0
Paratype 3	9.5	7.5	11.6	13.1	27.1	12.6	11.1	7.5
Mean	10.4	7.6	11.8	13.2	25.1	12.8	11.4	7.8
Interval/ab	1.4	1.0	1.6	1.8	3.3	1.7	1.5	1.0
Segment XX								
Holotype	11.7	6.2	11.3	15.2	24.1	14.4	11.3	5.8
Paratype 2	11.9	6.2	9.3	15.0	22.8	14.0	11.4	7.3
Paratype 3	9.9	6.8	12.6	12.6	27.2	12.6	12.6	5.8
Mean	11.3	6.4	11.1	14.3	24.7	14.1	11.8	6.3
Interval/ab	1.7	1.0	1.7	2.2	3.9	2.2	1.8	1.0

18/19, a small indistinct eyelike marking present postero-laterally to each pit (H, see Field Variation). Female pores inconspicuous midway between the setal arc and anterior border of XIV, shortly median of *a* (H, P1). Spermathecal pores 3 pairs in 6/7, 7/8 and 8/9, in *b* lines (and with inconspicuous elliptical lips, (H)) or shortly lateral of *b* lines, and preceded by a semicircular swelling which fills the posterior third of the previous segment (P1).

Septa 8/9–11/12 strongly thickened. Dorsal blood vessel single, continuous over the pharynx. Supra-oesophageal vessel traced into VIII, not demonstrable in VII, ending posteriorly in XIII, receiving a transverse vessel from each of the calciferous glands, in X–XIII. Last hearts in XIII, those in X–XIII, which are stout, originating from the calciferous vessels and receiving slender connectives from the dorsal vessel (latero-oesophageal hearts); commissurals in VII–IX more slender, dorso-ventral only and, unlike the latero-oesophageal hearts, with parietal branches but nevertheless valvular; vessels from the dorsal vessel in V and VI branching on the gut. Gizzard broad, glossy, strong but faintly easily compressible (H) or elongate and firm (P1), the preceding oesophagus, in IV, forming a wide flaccid proventriculus. Oesophagus unmodified in IX, bearing 4 pairs of ventrolateral broadly sessile extramural calciferous glands, in X–XIII, the lumen of each gland almost occluded by numerous radial lamellae. Oesophagus short, narrow and chloragogenous in XIV, Intestinal origin XV; typhlosole absent. Holonephric, nephridia with moderately large subspherical terminal vesicles, which are readily visible in the posterior intestinal region, are less well developed in the anterior intestinal region and not apparent in the forebody; presepial funnels large, in *ab* irrespective of position of bladder (first demonstrated in XIV). Compacted sperm masses surrounding iridescent sperm funnels in X and XI; seminal vesicles racemose, in IX and XII. Large racemose prostates a pair, in XVI XXI, a U-shaped muscular duct passing medianly from the middle region of the gland; the duct bifurcating at its ental extremity to receive ducts from the anterior and posterior portions of the gland; vas deferens joining the duct near its ectal end.

Perianal setae slender, sinuous, almost filiform, the ectal region, viewed from either side, ornamented with irregular, approximately transverse to oblique rows of a few (P1) to several

(H) triangular flattened scales, which except at their bases, are free from the setal surface but point towards the ectal extremity of the seta; the scales in the holotype with single, bifid or trifid points and in two or three groups, each group corresponding approximately with one of the coarser scales of paratype 1; total number of scales counted in a longitudinal line approximately 21 (in 0.21 mm) and 37 (in 0.44 mm) in two setae of the holotype; each seta tapering to a rounded but delicate point; length of a fully developed seta 2.9(P1)–3.7(H) mm; width of the most strongly ornamented region 27 or 20 μ m (H) and 23 μ m (P1). Female organs not observable (H); ovaries with numerous egg strings, and funnels in XIII; ovisacs absent. Spermathecae three pairs discharging anteriorly in their segments; ampulla subspherical, slightly shorter than the stoutly fusiform muscular glossy duct; an abruptly widening clavate diverticulum less than one third the length of the duct arising from the median aspect of the duct shortly ectal of the ampulla (H, P1).

Field variation: In the four type specimens paired pads in *ab*, which do not include the anterior portions of their segments, are present in VI, VII and VIII in H (R), P2 and P3. A liplike swelling extending to the preceding setal arc is present in these segments in front of each spermathecal pore in P1–3. An unpaired midventral circular postsetal marking with porelike centre is present in each of segments VI, VII and VIII in P2 or in VIII only in P3. Paired pads median to setae *b* and occupying much of the length of the segment are present in X in P1 and P3, in XI in H and P1 and 3, and in XII in H, P2 and P3. Paired pits in *ab* lie in intersegment 17/18 and immediately behind 18/19 in H, P1, 2 and 3. Paired oval pads in *ad* occur in XXII in P2 but there is only one, unilateral pad in H(R), P1(R) and P3(L). Indefinite tumid areas may be present in the vicinity of the paired pits of 17/18 and 18/19, i.e. ill defined eyelike markings posterolateral to the pits in XVIII and XIX in H or posteromedian to the pits in XVIII in P1 and P3 and in XIX also in P1.

Material examined: LH, 140°49'E, 37°28'S, 11 km S of Penola in eucalypts fringing *Pinus radiata*. B.J. and T.W., 15.viii.1972–H, Lk2, 140°42'E, 36°37'S, 37 km from Bordertown along road to Naracourt, in bank of temporary pool in grassland with sparse grass-trees and eucalypts, T.H., 16.viii.1972–P4, Lk4, 140°44'E, 36°59'S, 2 km S of

Naracoorte, in sandy soil with bracken and wattles near pasture, B.J. and T.W., 16.viii.1972-P1-3, H(AM)1, P1-2(B); P4(BM); P3(SAM).

Remarks: The new material agrees with *H. shephardi* alone in the genus (vide Jamieson 1970) in alternation of nephropores between *d* and mid *bc*, rather than the usual *d* to *c*, and it is here included in *H. shephardi* as a new subspecies although it shows differences, including the distribution of genital markings and the presence of penial setae, which might be considered to warrant separate specific status. Whether or not it be reproductively isolated from the nominate subspecies it is unquestionably, from its morphology, more closely related to the latter than to any other taxon in *Heteropodrilus*. *H. shephardi* belongs to a group of species with four pairs of calciferous glands, the other members of which are *H. canalicularis* (Fletcher 1889a) and *H. mediterraneus* (Fletcher 1888b). The latter two species occur terrestrially in upper reaches of the Murray-Darling river system while *H. shephardi* occurs on the Wimmera River.

Tribe MEGASCOLECINI s. Jamieson, 1971a

Male and prostatic pores coincident on XVIII (rarely XVII); prostates one pair, racemose (with branched internal ducts and no single ventral lumen) or tubular (with a single central lumen). Purely metonephric; median stomate nephridium, if present, opening into the intestine.

Genus GEMASCOLEX Edmonds & Jamieson, 1973

Terrestrial. Body circular in cross section or (*G. bursatus*) dorsoventrally depressed. Prostomium epilobous to tanylobous; peristomium bisected by a longitudinal furrow ventrally, which is more conspicuous than other grooving which may be present, or (*G. mirabilis* and *G. stirlingi*) grooving present all round but not more conspicuous ventrally. Setae numerous (more than 8) in each segment. Nephropores not externally recognizable. A pair of combined male and prostatic pores on XVIII. Clitellum annular anterior to 18/19; its intersegments and dorsal pores obscured at maturity but setae visible. Intersegmental accessory genital markings always present. Female pore presetal in XIV and midventral or, as a rare individual variation (*G. lateralis*), paired. Spermathecal pores 2-4 pairs in 5/6-8/9, 2 pairs in 6/7 and 7/8, or a pair in 5/6 only.

Dorsal blood vessel single; continuous onto pharynx. Hearts in X posteriorly latero-oesophageal, each arising from the short supra-oesophageal vessel and from the dorsal vessel. Last hearts in XII or XIII, latero-oesophageal vessels (always?) present median to the hearts. Subneural vessel absent. Gizzard large, in V or VI. Oesophagus lacking extramural calciferous glands. Intestine commencing in XVII; a ridge-like low or (*G. walkeri*) deep dorsal typhlosome present; caeca and muscular thickening absent. Excretory system metonephric. Paired tufts present in II, III-V of which at least those in IV and V are enteronephric, with ducts entering the buccal cavity and/or the pharynx. Caudally with numerous enteronephric metonephridia, each with a preseptal funnel, discharging into the intestine in each segment and with or without a longitudinal collecting duct (ureter) on each side. Testes and funnels in X and XI; testis-vacs absent; seminal vesicles in XI and XII or rarely in IX, XI and XII.

Ovaries and funnels in XIII; ovisacs present or absent. Prostates tubuloracemose: linear, lobulated, with axial lumen throughout which receives lateral canaliculi; vas deferens joining their muscular ducts. Penial setae absent. Spermathecae with diverticula.

Type-species: *Gemascolex newmani* Edmonds & Jamieson, 1973.

Distribution: South Australia and Victoria.

CHECKLIST OF SPECIES

*New combinations in *Gemascolex*

South Australia:

1. *Gemascolex bursatus* sp. nov.
2. *Perichaeta lateralis** Spencer, 1892 (also Victoria), syn. *Megascolex zietzi* Michaelson, 1907b
3. *Gemascolex mirabilis* sp. nov.
4. *Gemascolex newmani* Edmonds & Jamieson, 1973
5. *Gemascolex octothecatus* sp. nov.
6. *Gemascolex similis* sp. nov.
7. *Perichaeta stirlingi** Fletcher, 1888a, syn. *Megascolex fletcheri* Shannon, 1920
8. *Gemascolex walkeri* sp. nov.

Victoria:

9. *Perichaeta dorsalis** Fletcher, 1888b

Gemascolex bursatus sp. nov.

FIGS 3A, 10C, 11B-E; TABLE 4

Length = 52(P1)-64(H) mm, w (midclitellar) = 1.5(P1)-2.5(H) mm, s = 81(P1)-102(H). Pigmented purplish-brown dorsally, pale ventrally; setae in pale circular fields.

TABLE 4
Intersetal distances in *Gemascolex bursalus*

	mm					standardized as % of circumference			
	ap	ab	ap	az	u	am	ab	az	u
Segment XI									
Holotype	0.6	0.4	0.4	0.5	5.2	12.2	7.6	7.3	10.7
Paratype 1	0.4	0.3	0.3	0.4	4.2	8.4	6.0	7.1	10.1
Mean						10.3	6.8	7.5	10.2
Interval/ab						1.5	1.0	1.1	1.5
Segment XX									
Holotype	0.7	0.5	0.4	0.3	5.8	12.8	8.8	7.3	14.0
Paratype 1	0.6	0.3	0.3	0.5	4.6	13.6	6.5	6.9	10.6
Mean						13.2	7.6	7.1	12.3
Interval/ab						1.7	1.0	0.9	1.6

Prostomium tanylobous, narrow, acute (H) or epilobous, 3/4, open. Canalicula absent. Dorsal pores minute, the first in 4/5. Setae of each side more closely spaced laterally than dorsally and ventrally; *ab* and *bc* approximately equal. Numbers of setae per segment 18 in XII, 16 in XX (H, P1), 20(P1)–22(H) fifteen segments from the caudal end; *a* and *z* lines straight throughout; anteriorly with a wide break in the setal circle dorsally and ventrally; posteriorly with a moderate ventral and almost inappreciable dorsal break. Setae *a* and *b* but not *c* absent in XVIII. Clitellum (developed in holotype only) XIII–XVI (= 4 segments). Male pores extensive transverse slits, with puckered lips but no porophores, immediately median to setae *c* of XVIII, 1.05(H)–1.30(P1) mm, 0.29(P1)–0.38(H) circumference, apart. A circular, low dome-shaped accessory genital marking present at 17/18 and 18/19 in front of and behind the male pore, on the left side, but at 18/19 only on the right side (H); paired in these locations in P1. A pair of elliptical eyelike markings in 16/17 in *ab* (H only) and a further pair of circular to elliptical markings in 8/9 slightly lateral of *b* lines (H, P1); all accessory genital markings rudimentary in P1. Spermathecal pores 2 pairs, in 7/8 and 8/9, laterally situated gaping clefts, shortly lateral of setal lines 4, 1.32(H)–2.0(P1) mm, 0.48(P1)–0.56(H) circumference, apart.

Strongest septa 9/10–13/14, moderately strongly thickened. Last hearts in XII. Supraoesophageal recognizable in VII(H), VIII(P1)– $\frac{1}{2}$ XIII(P1), XIII(H), well developed. Gizzard in V. Intestine originating in XVII in which it resembles the vascularized regions of the oesophagus; a low tortuous dorsal typhlosome first considerably developed in XXVIII but traceable forward as a rudiment to XXIII. Nephridia: a pair of tufts in each of segments II–V, increasing from small to large posteriorly; those in IV and V sending

composite ducts to the pharynx; those in II and III apparently exonephric; small exonephric tufts in VI accompanied laterally by micromeronephridia (H, P1); numerous integumentary micromeronephridia in VII posteriorly, at first posterior in their segments (H, P1); in XVI–XVII especially conspicuous and densely crowded on the body wall (H); thereafter (H, P1) moderately numerous on each side and posterior in each segment; caudally with several (as many as 8 or 9) enlarged nephridia on each side with a preseptal funnel, at least some of these nephridia on each side sending ducts to the roof of the intestine; accompanied in the holotype by smaller astomata, (exonephric?) nephridia; no ureters demonstrable. Precise description of the nephridia must be postponed until more appropriately fixed material is available.

Sperm funnels in X and XI (iridescent in the mature holotype); seminal vesicles racemose, in XI and XII. Ovaries oval laminae with several large oocytes (H), rudimentary in the paratype; accompanied medianly by small sacs of unknown function; ovisacs present. Prostates tubuloracemose, each with flattened leaflike glandular portion, in XXII–XXVI, XXVII, deeply incised by the septum and adherent to the intestine; the muscular duct straight in XIX–XXII but in XVIII curving medianly around the anterior face of a large subspherical bursa copulatrix. A conical penis-like structure projecting from the bursa into the male genital aperture though not visible externally; vas deferens joining the junction of prostate duct and gland (H); prostate glands rudimentary in P1.

Spermathecae 2 pairs, in VIII and IX; duct, ampulla and diverticulum tortuous; the diverticulum (inseminated) slender, tubular, unifoliate, a little larger than the ampulla (H); spermathecae rudimentary in P1.

Material examined: J13, 138°30'E, 35°22'S, hill 8 km from Myponga, S. *Edmonds*, 16.viii.1972–H(AM), P1(BJ).

Remarks: The muscular bursae at the ectal ends of the prostate ducts in this species are unique in the genus.

Gemascolex lateralis (Spencer, 1892)

FIGS 4A, B, 10D–F, 11F; TABLE 5

Perichaeta lateralis Spencer, 1892: 11–12, Pl. VI, figs 55–57, 78.

Megascolex lateralis Michaelsen, 1900: 220. Jamieson, 1971b: 95.

Megascolex zietzi Michaelsen, 1907b: 17–19. Jamieson, 1971b: 95.

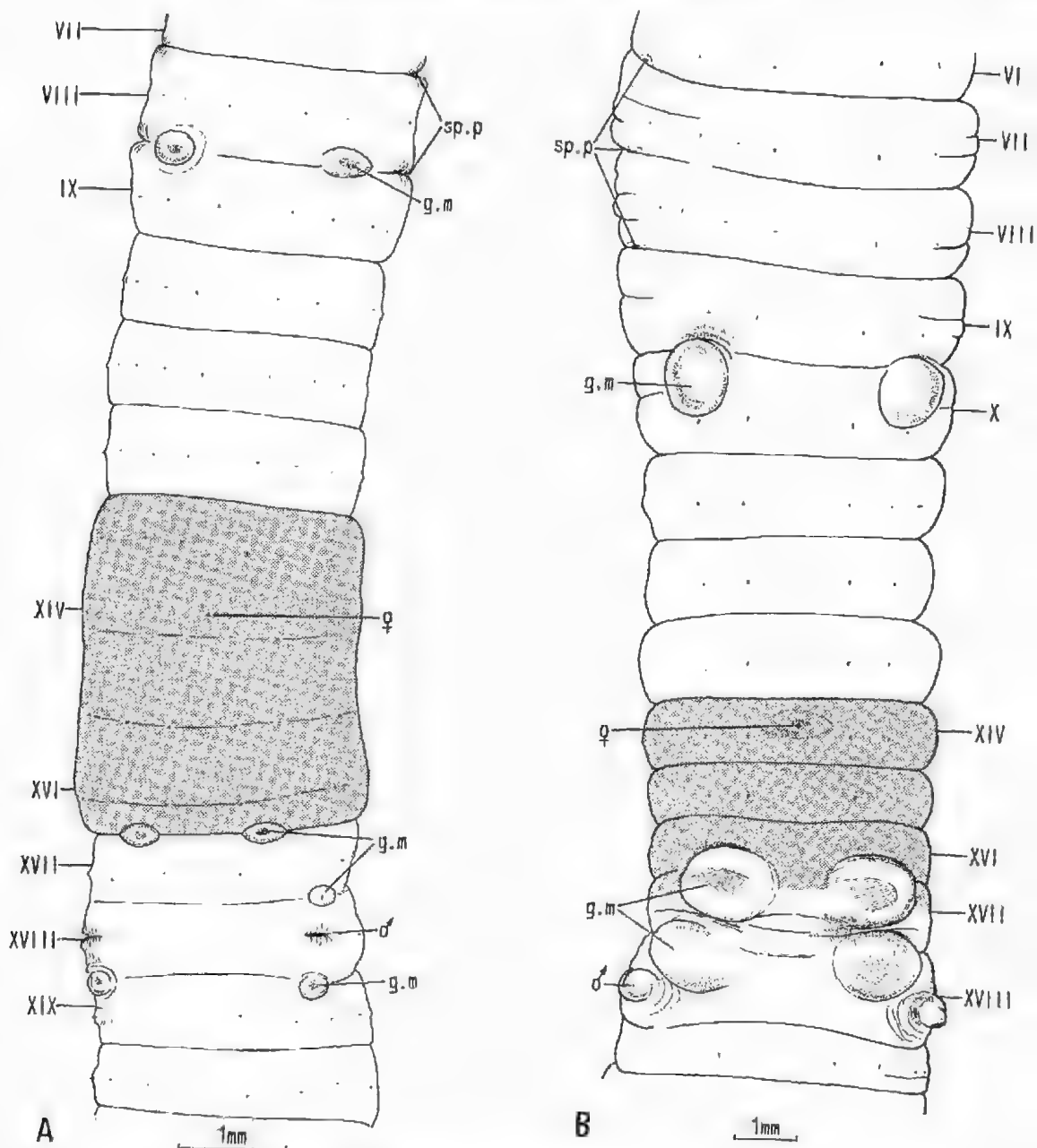


Fig. 3. Genital fields of: A, *Gemascolex bursatus*, holotype, Jj3. B, *G. similis*, holotype, Ll2.

The following account is drawn from the lectotype, two specimens from locality Ji2 (SA77, 79), a specimen from Ll1 (SA15), and one from Lk3 (SA229). These are referred to as L, and specimens 1, 2, 3 and 4 respectively in the account.

Length = 45 (specimen 3), 74 (specimen 2)–80(L) mm (specimens 1 and 4 are pos-

terior regenerates), w (midclitellar) = 3–4 mm, s = 87 (specimen 3), 109 (specimen 2)–122(L). Circular in cross section. Pigmented purplish brown dorsally with the setae in pale fields (specimens 1 and 2); or pigmentless (bleached?) (L; specimens 3 and 4). Prostomium epilobous 1/2 (specimens 3 and 4) and 2/3 (specimens 1 and 2) or appearing

TABLE 5
Intersetal distances in *Gemasclex lateralis*

Segment	aa	ab	mm			u	standardized as % of circumference			
			2y	7y	u		aa	ab	2y	7y
Segment XII										
1 SA 77	1.1	0.5	0.7	1.1	11.6		9.4	4.6	6.1	9.4
2 SA 79	1.0	0.8	0.3	1.2	11.9		8.5	6.6	3.6	11.3
3 SA 15	0.6	0.3	0.3	0.9	7.8		7.2	4.0	3.6	11.3
4 SA 229	0.7	0.4	0.5	0.9	9.2		7.6	4.4	5.4	9.2
Segment XX										
1 SA 77	1.3	0.5	0.5	1.4	12.1		10.4	4.5	4.4	8.9
2 SA 79	1.4	0.8	0.6	1.2	13.1		10.7	5.9	4.8	8.9
3 SA 15	1.0	0.5	0.4	1.1	9.3		10.5	5.3	3.8	11.0
4 SA 229	1.1	0.5	0.5	1.3	9.5		11.6	5.3	5.3	13.7

tanylohaus (L); not or faintly canaliculate, closed or open. First dorsal pore 4/5. Setae more closely spaced ventrolaterally than dorsally and ventrally on each side; *ab* significantly, but not greatly larger than *ba* in most segments; numbers of setae per segment 21–31 (mean of 5 = 26) in XII, 17–24 (mean of 5 = 22) in XX, 20–38 (mean of 5 = 26) fifteen segments from the caudal end; a distinct though only moderately wide ventral break present throughout; a dorsal break present in the forebody but behind the clitellum only initially recognizable, or present but narrow throughout. Setae *a*, *b* and *c* absent in XVIII or (L) *a* and *b*, only absent.

Clitellum XIII (specimens 2–4), XIV (L; specimen 1)–XVI (L, specimen 1, 2), 1/3 XVII (specimens 3 and 4) (= 3–4 1/3 segments). Male pores on prominent rounded porophores in *c* lines of XVIII, distance apart = 2.04 (specimen 3), 2.81 (specimen 4), 3.1 (L), 4.04 (specimen 1), 4.92 (specimen 2) mm; ratio of this to circumference = 0.26 (L), 0.30 (specimen 4), 0.31 (specimen 3), 0.33 (specimens 1 and 2). Accessory genital markings: a pair of eyelike markings in each of intersegments 9/10 and 10/11 in *ab* (L; specimens 1–4). Additional markings in 17/18–21/22, varying from *a* lines at 17/18 to slightly median of *a* at 21/22 (L), or in 17/18–22/23 (specimens 1 and 2) or absent (specimens 3 and 4). A further pair of sub-circular markings present in XVIII in front of the male pores (L; specimens 1–4) and a second pair behind them (specimens 1 and 2) (see Field Variation). Spermathecal pores 3 pairs, clearly visible sunken orifices or inconspicuous, in 6/7–8/9, between setal lines 4 and 5; distance between pores = 2.04 (specimen 3), 3.0 (specimen 4), 4.5 (lectotype), 4.92 (specimen 1), 5.62 (specimen 2) mm; ratio of this distance to circumference = 0.24 (specimen 3), 0.34 (specimen 4), 0.35 (lectotype), 0.38 (specimen 2), 0.42 (specimen 1).

Several pre-intestinal septa thickened but none strongly. Last hearts in XII. Supra-oesophageal vessel in 1/2 VIII–1/2 XIII, well developed (specimens 1 and 2); ill-defined in specimens 3 and 4. Vascular system not intact in the lectotype. Gizzard in V, Intestinal origin XVII; a very low, rudimentary, dorsal typhlosole first definitely recognizable in XXVII. Nephridia: small paired tufts in II and III with anterolaterally directed composite ducts which in specimens 1–4 appear to be exonephric but in the lectotype join the buccal cavity at its anterior limit. Large tufts in IV and V enteronephric, their composite ducts running anteromedially to join the pharynx. Numerous exonephric astomate micromeronephridia present in I or more bands in V posteriorly (visible from II in specimens 3 and 4), associated with the anterior and posterior septa in XV (specimens 1 and 2) or XVII (specimens 3 and 4) posteriorly. Caudally with approximately 8 enlarged nephridia, each with a pre-septal funnel on each side; one or two nephridial ducts traced to the roof of the intestine but probably all enteronephric; no longitudinal collecting ducts demonstrable. Sperm funnels iridescent in X and XI; seminal vesicles slightly racemose, almost sacciform, 2 or 3 pairs, in IX (L, specimens 1 and 2), XI and XII (all specimens). Ovaries, flattened webs or lobes with several conjoined strings of large oocytes, and funnels; a crescentic sac of unknown function seen on the anterior septum of XIII median to the ovaries in the lectotype and specimens 1 and 2; sacs on the anterior septum of XIV questionably ovisacs. Prostates tubuloracemose, hand-sections of one of specimen 3 revealing a very narrow central lumen; the broad glandular portion linear, in XVIII–XXII, XXIII deeply incised by the septa; the muscular duct forming a loop at least the ectal limb of which widens strongly but a copulatory bursa absent; the vas deferens joining the duct near its junction with the gland. No glandular masses distinguishable internally at the sites of the accessory genital markings. Spermathecae 3 pairs, diverticulum (inseminated) single, tubular, very long and much coiled.

Field variation: Anterior genital markings are commonly absent in specimens with well developed markings in the vicinity of the male genital field. When anterior markings are present they usually occur in 9/10 and 10/11 but they sometimes are present in 10/11 only and rarely in 8/9 only; there are rarely 3 pairs.

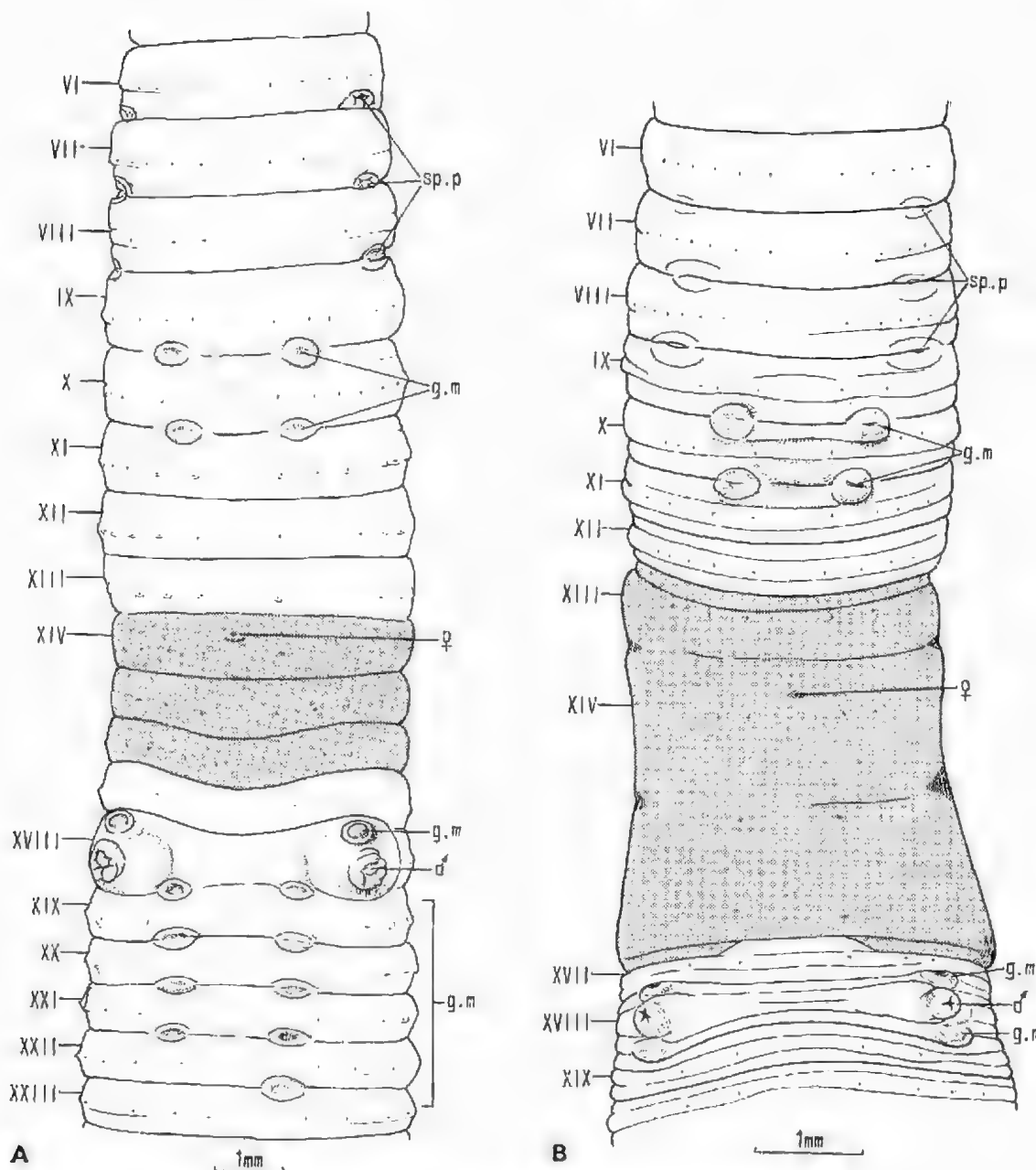


Fig. 4. *Gemascolex lateralis*. Genital fields of: A, specimen 1, J12; B, specimen 3, L11.

in 8/9, 9/10 and 10/11. A pair of markings is invariably present in XVIII in front of the male pores and a further pair is usually present behind the pores. In no specimens are the posterior markings present in the absence of the anterior pair.

Paired intersegmental genital markings in the vicinity of the male pores may be absent

but they are usually present in 18/19, 19/20, commonly in 20/21 and 21/22 and less frequently in 17/18 and 22/23.

In all but one of the many specimens examined, the female pore was unpaired.

Material examined: Ig1, 138°03'E, 32°46'S, Alligator Gorge National Park, under rocks near creek in gorge, B.J. and T.W.,

19.viii.1972—SA 26–30, 33. Jh2, 138°38'E, 33°55'S, 10 km S of Clare on road to Auburn, under eucalypts, B.J. and T.W., 18.viii.1972—SA 165, SA 170, SA 318, 319. Jj2, 138°24'E, 34°58'S, Mt. Lofty, T.W., 16.viii.1972—SA 306. Mt. Lofty, in eucalypt woodland, B.J. and T.W., 16.viii.1972—SA 289–296, 298, 299, 301–302, 304, 305; Mt. Lofty area, in moist soil in eucalypt sclerophyll, T.W., 20.viii.1972—SA 77, 78, 79, 82, 85. Jj1, 138°41'E, 35°07'S, Mt. Bold reservoir, on hillside with eucalypts and grass, T.W., 21.viii.1972—SA 57–60. Jj2, 138°43'E, 34°14'S, Kyeema National Park, near creek and under logs in eucalypt sclerophyll and in swamp, T.W., 21.viii.1972—SA 271, 279, 286, 287. Jj3, 138°30'E, 35°22'S, 6.5 km from Myponga, S. Edmonds, 16.viii.1972—SA 236, 237. Jj4, 138°31'E, 35°26'S, near Mt. Clark (S of Myponga), eucalypt sclerophyll, T.W., 21.viii.1972—SA 64, 69–72. Jj5, 138°11'E, 35°36'S, 8 km from Cape Jervis along road to Victor Harbor, in grass-tree, bracken and eucalypt bushland, T.W., 21.viii.1972—SA 265, 267. Jj6, 138°21'E, 35°34'S, 24 km from Cape Jervis along road to Victor Harbor, under rocks and logs in poor soil, T.W., 21.viii.1972—SA 207, 209, 210, 215. Jj7, 138°25'E, 35°33'S, 30 km from Cape Jervis along road to Victor Harbor, in grass-tree and eucalypt mulga, T.W., 21.viii.1972—SA 172, 176. Jj8, 138°32'E, 35°34'S, 10 km from Victor Harbor to Cape Jervis, under roadside log, T.W., 21.viii.1972—SA 42 (immature). Kj1, 139°28'E, 35°15'S, Tailem Bend, under rocks on bank of the Murray River, B.J. and T.W., 16.viii.1972—SA 188–190, 192–193, 195–201, 203–205. Lk3, 140°38'E, 36°42'S, 32 km from Naracoorte to Bordertown, in sandy soil among *Banksia*, gums and bracken, B.J. and T.W., 16.viii.1972—SA 219–230. Ll1, 140°49'E, 37°28'S, 11 km S of Penola at roadside, under eucalypts fringing *Pinus radiata*, B.J. and T.W., 15.viii.1972—SA 15. Ll2, 140°32'E, 37°41'S, 18 km SE of Millicent on road to Mt. Gambier, in sandy soil with grass, bracken and *Drosera* fringing a *Pinus radiata* plantation, T.W., 15.viii.1972—SA 47 SA 15, 79 (AM); SA 77, 229 (BM); SA 289 (SAM); the remaining specimens (BJ).

Remarks: Examination of the lectotype of *Perichaeta lateralis* reveals the presence of paired genital markings, overlooked by Spencer, in 9/10 and 10/11 and does not confirm

pairing of the female pore reported in his description. Agreement of the new material, and Michaelsen's description of *Megascolex zietzi*, with the lectotype is so close as to allow no doubt of conspecificity.

The possibility that an infraspecific morph, subspecies or, less likely, a sibling species should be recognized for at least some populations which have genital markings on XVIII both behind and in front of the male pores deserves investigation. In such specimens (exemplified by specimens 3 and 4) the male spermathecal pores, although in the same setal lines as the typical morph, (exemplified by the lectotype and specimens 1 and 2) are usually closer together transversely. The spermathecal diverticula are, so far as investigated, shorter and less convoluted. Furthermore, paired intersegmental genital markings in the vicinity of the male pores may be absent though frequently present. The occurrence sympatrically on Mt. Lofty of specimens with or without markings behind the male pores, in addition to those in front, at present militates against recognition of subspecies. However, it is hoped that a statistical examination of morphology in populations of *G. lateralis* and of their biology will be undertaken by workers in South Australia with a view to determining the status of the variants mentioned.

G. lateralis is the only indigenous megascolecoid, other than *Heteroporodrilus shephardi*, known to occur outside South Australia (in Victoria).

Gemascolex mirabilis sp. nov.

FIGS 5, 10G; TABLE 6

Length = 60(H)–83(P1) mm, w (mid-clitellar) = 5.5(H)–6.9(P1) mm, s = 120(P1)–128(H). Circular in cross section. Pigmentless with the exception of the brownish clitellum. Prostomium epitanylobous, closed at 1/3 peristomium and lateral borders to 0/1 not certainly distinguishable from longitudinal furrows on the peristomium but bisected by a deep canalicula to 0/1. Peristomium longitudinally grooved all round but not bisected ventrally. First dorsal pore 3/4, (imperforate?, P1), 4/5 (H, P1). Setae subequally spaced, though *bc* is slightly wider than *ab* throughout. Numbers of setae per segment 20(P1)–21(H) in XII, 21(P1)–22(H) in XX, 20(H)–21(P1) fifteen segments from the caudal end; *a* lines straight throughout; *z* lines straight anterior to, irregular posterior to the clitellum; *a* ventral

TABLE 6

Intersetal distances in Gemascolex mirabilis

	mm.					standardized as % of circumference			
	aa	ab	2a'	2c	u	aa	ab	2a'	2c
Segment XII									
Holotype	1.0	0.4	0.7	1.5	12.5	7.6	3.5	5.7	11.8
Paratype 1	1.2	0.6	0.8	1.7	15.7	7.4	4.0	5.4	10.5
Mean						7.5	3.8	5.3	11.1
Interval/ab						2.0	1.0	1.6	3.0
Segment XX									
Holotype	0.7	0.4	1.2	1.9	13.9	5.3	2.5	8.6	17.9
Paratype 1	1.4	0.6	1.0	2.0	17.6	8.0	3.6	5.8	11.2
Mean						6.7	3.1	7.2	12.5
Interval/ab						2.2	1.0	2.4	4.1

and a dorsal break present throughout. Setae *a* and *b*, but not *c*, absent in XVIII.

Clitellum XIII(P1), 1/3XIII(H)-XVII(H); 1/3XVIII(P1) (= 4 2/3-5 1/3 segments). Male pores minute longitudinal slits in *ab* near the median borders of a pair of large porophores; the pores 1.40(H)-1.79(P1) mm, 0.09(H)-0.10(P1) circumference apart. Accessory genital markings paired transversely elliptical tumescences, with slit like centres, extending from lateral of *c* to median of *b*, in 16/17(P1), 19/20, 20/21(H, P1), 21/22 and 22/23(H). Spermathecal pores 2 pairs of small pores concealed in 6/7 and 7/8, in *ab*, nearer *a*, with a faintly demarcated lip in front of each on the preceding segment; the pores 1.37(H)-1.72(P1) mm, 0.09-0.11 circumference apart.

Strongest septa 9/10-12/13, moderately strongly thickened. Last septal glands in IV, not involving the gizzard. Last hearts in XIII. Connectives in X-XIII from supra-oesophageal larger than the dorsal connectives and each joined before it reaches the latter vessel by a vessel from the corresponding side of the oesophageal wall. Supra-oesophageal in X-XIII, weakly developed despite the large size of the connectives to the hearts. Gizzard in V. Oesophagus almost suppressed to VIII and short in IX owing to backwards projection of the gizzard; vascularized (though not conspicuously) and dilated in X-XIII, with high internal villi almost occluding the lumen but not uniting axially. Intestinal origin XVII; a well developed, though low, tortuous dorsal typhlosole commencing in XXV(P1) or XXVI(H). Nephridia: a large pair of tufted nephridia, with innumerable spiral loops, in VI sending several composite ducts anterolaterally and anteromedially to the body wall anteriorly in this segment; an extremely large pair of tufts in V sending composite ducts to the pharynx and additional long composite ducts far forward to the vicinity of intersegment 1/2. Very small pharyngeal tufts in IV (H, P1) a

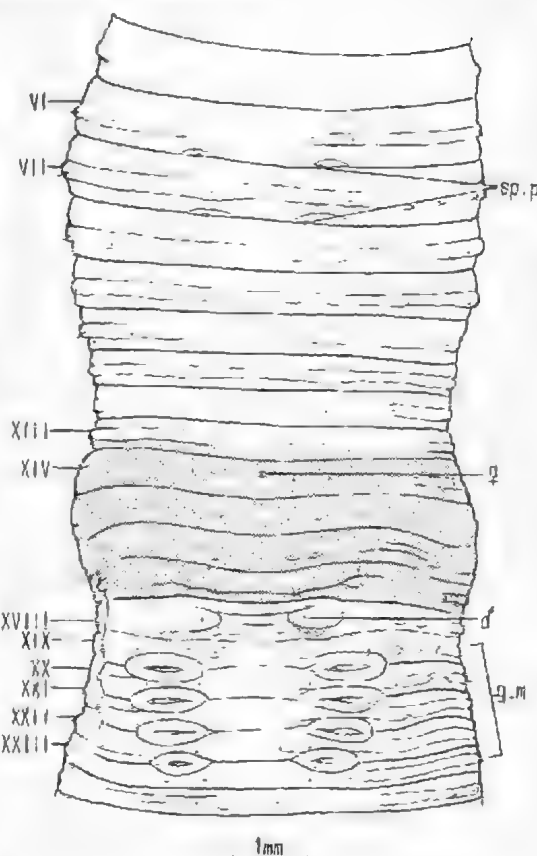


Fig. 5. *Gemascolex mirabilis*. Genital field. holotype 1g2.

rudimentary tuft on each side in III(H); none detectable in II(H) or in II and III(P1). Lateral bands of astomate, exonephric micromeronephridia posterior in their segments in VII-XII(H), XIII(P1) then becoming progressively more anterior until in XV(P1) or XVI(H) they are attached to the anterior septum, the bands especially dense in XIII-XVII; in the anterior intestinal region with approximately 13 compact astomate micromeronephridia on each side dependent from the anterior septum but exonephric. Caudally with approximately 8 enlarged nephridia on each side, closely adjacent to and encircling the intestine from almost the middorsal line laterally; each with a large, long-stalked pre-septal funnel; these nephridia sending separate ducts medially to unite as a common duct which passes diagonally, posteromedially, beneath the dorsal blood vessel on each side, to enter the body wall posteriorly in the segment; the diagonal duct on each side communicating by a narrower duct with that of the

next adjacent segments. Numerous astomate, apparently exonephric, septal micromeronephridia present at the parietes, surrounding and concentric with the enlarged, enteronephric nephridia (H, P1). Sperm funnels weakly iridescent in X and XI. Seminal vesicles racemose, in XI and XII. Ovaries composed of several partly united strings of large oocytes. Flattened saclike structures in XIV may be ovisacs. Prostates tongue-shaped, restricted to and passing laterally in XVIII, incised once to twice so as to suggest a modified, depressed tubular form (H, P1); with a narrow central lumen throughout which has epithelium-lined side branches (schizoparatype); the muscular duct widening significantly towards the pore and joined near its ental end by the vasa deferentia, these male ducts running separately from each other in the thick muscular wall of the prostate duct near the lumen of the latter, but not penetrating the lining epithelium to join the lumen until the male pore is almost reached (schizoparatype); copulatory bursa absent. Spermathecae 2 pairs, in VII and VIII, the single diverticulum subspherical, sessile, with several internal inseminated loculi; the duct inflated, spindle shaped (H, P1, schizoparatype).

Field variation: In 11 clitellate type-specimens, including the holotype, genital markings are in 15/16 (left) in specimen (P10); 16/17 in 6 (5 paired, 1 right); 19/20 and 20/21 in 11 (all paired in 19/20; unilateral right or left in 2 in 20/21); 21/22 in 2 (1 paired, 1 right); and 22/23 in 1 (paired). The male porophores in some specimens are surrounded by a common, medianly narrowing field raised at its edges as a rimlike tumescence which is closely adjacent to the lateral borders of the porophores.

Material examined: Jg2, 138°10'E, 32°48'S, Mt. Remarkable, on slopes of mountain in rocky soil covered with animal (wallaby?) droppings, B.J. and T.W., 18.viii.1972—H, P1–10, P11 (schizoparatype); many other specimens collected but not designated type-specimens. Jg1, 138°03'E, 32°46'S, Alligator Gorge National Park, under rocks near creek in gorge, B.J. and T.W., 19.viii.1972—P12, H, P2–5 (AM); P1, P6 (BM); P7–8 (SAM); P9–12 and others (DJ).

Remarks: Location of the two pairs of spermathecal pores in 6/7 and 8/9 and the configuration of the genital markings readily distinguish *G. mirabilis* from other species.

***Genioscolex octothecatus* sp. nov.**

FIGS 6A, B, 10H, I; TABLE 7

Length = 45(P1)–64(H) mm, w (mid-clitellar) = 4.7–5.4 mm, s = 71(P1)–84(H) (posterior regenerates?). Generally circular in cross section but the ventral surface somewhat flattened at and anterior to the male genital field. Pigmented purplish brown dorsally, colorless ventrally, in alcohol; each seta in the pigmented areas surrounded by a colorless circular field. Prostomium not canaliculate (H) or with weak dorsal canalicula (P1), epilobous 1/3(H)–1/2(P1), closed by a deep transverse furrow but continuing posterior as an acute (H) or parallel-sided (P1) tongue which almost reaches the first intersegment. First dorsal pore 4/5. Setae of each side more closely spaced laterally than dorsally and ventrally; *ab* significantly larger than *bc*; the setae of the ventral couple more conspicuous than others. Numbers of setae per segment 20 in XII(H, P1); 18(P1)–19(H) in XX; 26(P1)–28(H) fifteen segments from the caudal end; *a* lines straight, *z* lines irregular; a wide ventral and dorsal break in the setal circle present throughout. Setae *a*, *h* and *c* absent in XVIII in the prostatic holotype but present in the aprostatic paratype 1.

Clitellum XIII(H), XIV(P1)–1/2XVII dorsally (= 3 1/2–4 1/2 segments) annular but ventrally (H) weakly developed in XIII and apparently not developed in XVII, intersegmental furrow 13/14 well demarcated ventrally (though not dorsally), the succeeding furrows weakly indicated; dorsal pore 13/14 well developed, 16/17 partly occluded, the others obliterated; setae *a* and *b* clearly visible, the remainder only sporadically visible (P1). Male pores minute, on stump-like, unannulated pseudopenes, in *cd* of XVIII, which are strongly protuberant from gaping slit-like surrounding basal areas which may represent the male pores before eversion of the pseudopenes, the basal slits each borne on a large annulated porophore; the bases of the pseudopenes 6.4 mm, 0.35 circumference apart (H). Male pores and porophores totally absent in paratype 1. Accessory genital markings paired with pore-like centres, presetally in X in *b*; in 16/17 centred in or slightly median of *b*; in 17/18 and 18/19 slightly lateral of *b*; and in 19/20 and 20/21 slightly median of *b* (H, see Field Variation). Spermathecal pores 4 pairs, in 5/6, 6/7, 7/8 and 8/9; in a straight line on each side but between setal lines 5 and 6 in 5/6, and between 6 and 7 in 8/9, distinctly


TABLE 7

Intersetal distances in Gemascolax octothecatus

	aa	ab	mm	zy	zz	y	standardized as % of circumference			
Segment XII							aa	ab	zy	z
Holotype	1.7	1.0	0.7	2.5	17.9		9.5	5.6	4.0	14.0
Paratype 1	1.1	0.8	0.6	1.3	13.4		8.2	5.6	4.5	9.0
Mean							8.9	5.6	4.3	11.5
Interval/ab							1.6	1.0	0.8	2.1
Segment XX										
Holotype	1.7	1.1	1.0	2.6	18.5		9.2	6.0	5.4	14.0
Paratype 1	1.1	0.8	0.6	1.3	13.1		7.8	5.3	4.3	9.2
Mean							8.5	5.7	4.9	11.6
Interval/ab							1.5	1.0	0.9	2.1

visible small whitish oval papillae confined to the intersegmental furrows; in 8/9, 7.7(P1)–9.9(H) mm, 0.57(H)–0.58(P1) circumference apart, i.e. slightly dorsal (H, P1).

Strongest septa 11, 12–13/14, moderately strong. Last hearts in XIII. Supra-oesophageal vessel in VII, 1/2VIII–1/2XIII, well developed. Hearts in V, VII–IX dorsoventral only, though still valvular, giving branches to septa and body wall, unlike the more posterior hearts. Gizzard in VI. Intestinal origin XVII; a very low, fairly broad dorsal typhlosole commencing in XIX. Nephridia: a pair of large tufts with many spiral loops in each of segments 11–V, increasing in size posteriorly, to very large in V; the tufts in II and III sending composite ducts forward in common to join the body wall near the buccal cavity and into the peristomium where they possibly enter the buccal cavity; those in IV and V discharging into the pharynx. Metanephridia: parietal and apparently exonephric in transverse bands in VI posteriorly; caudally, from approximately the 50th segment with 8 or more long-necked preseptal funnels on each side and with the median 2 of these stomate nephridia enlarged as megametonephridia the 4 of which lie on the dorsal surface of the intestine and send their ducts to the intestinal wall; the two ducts uniting on each side of the dorsal vessel, and in continuity with those of neighbouring segments; the longitudinal duct apparently but not certainly opening into the intestine posteriorly in each segment. Laterally the nephridia become progressively smaller, though each retains a preseptal funnel; they are dependent from the anterior septum and some at least send ducts to the roof of the intestine and are apparently also enteronephric. Elongate lobed testes and large complexly folded, pearly but not iridescent sperm funnels in X and XI; 2 or 3 pairs of moderately large sacciform seminal vesicles in IX(H), XI and XII (H, P1). Prostates large, broad lobed structures in

XVIII–XXI (left), –XXII right), each deeply incised laterally and less so medianly by the septa; the -shaped muscular duct entirely narrow, widening strongly and uniformly ecto-wards but lacking a terminal bursa; vas deferens joining it near its junction with the gland (H). Large, paired, low internal glandular masses in XVI–XXI corresponding with external accessory genital markings (H, P1). Prostates totally absent from paratype 1 although the specimen is mature; ectal portions of vasa deferentia not observable. Ovaries (bushy with many large oocytes (P1) or poorly developed (H)) and funnels in XIII, accompanied medianly by sacs of unknown function; sacs on the anterior septum of XIV may be ovisacs. Spermathecae 4 pairs, diverticulum single, elongate clavate, uniloculate, shorter (P1) or longer (H) than the spermatheca, sometimes coiled.

Field variation: Of the 6 type-specimens, only the holotype has male pores; 3 of the paratypes dissected, 1 of which is longer than the holotype and fully clitellate, have no prostate glands. Paired accessory genital markings anteriorly in X in *b* lines are invariably present as are paired markings in 16/17–19/20. They are present in 20/21 in paratypes 1 and 2, as in the holotype. Additional paired markings are present in 15/16 in paratype 3. A rudimentary marking is present unilaterally on the right, in 12/13 in paratype 4. In specimens lacking male pores the genital markings in 17/18–18/19 are slightly more median than in the prostatic holotype, lying in *ab* nearer *b*, rather than in *b* lines.

Material examined: L11, 140°49'E, 37°28'S, 11 km S of Penola in eucalypts fringing *Pinus radiata*, B.J. and T.W., 15.viii.1972—P1, Lm1, 140°55'E, 38°01'S, 27 km from Mt. Gambier along road to Nelson, in sandy loam under grass among wattles and gums with some herbaceous garden escapes, B.J. and T.W., 15.viii.1972—H. P2–5, H. P2 (AM): P1 (BM): P3 (SAM): P4 & 5 (BJ).

Remarks: *G. octothecatus* resembles *G. dorsalis* (Fletcher), from Victoria, in possessing four pairs of spermathecae and in the dorsal location of their pores. A further similarity between the two species is the pair of genital markings at the anterior margins of X and XVII. *G. dorsalis* differs, however, in restriction of genital markings to these locations in all localities from which it has been reported (Fletcher 1888b; Spencer 1892; Michaelsen 1907b); and in the more dorsal location of the

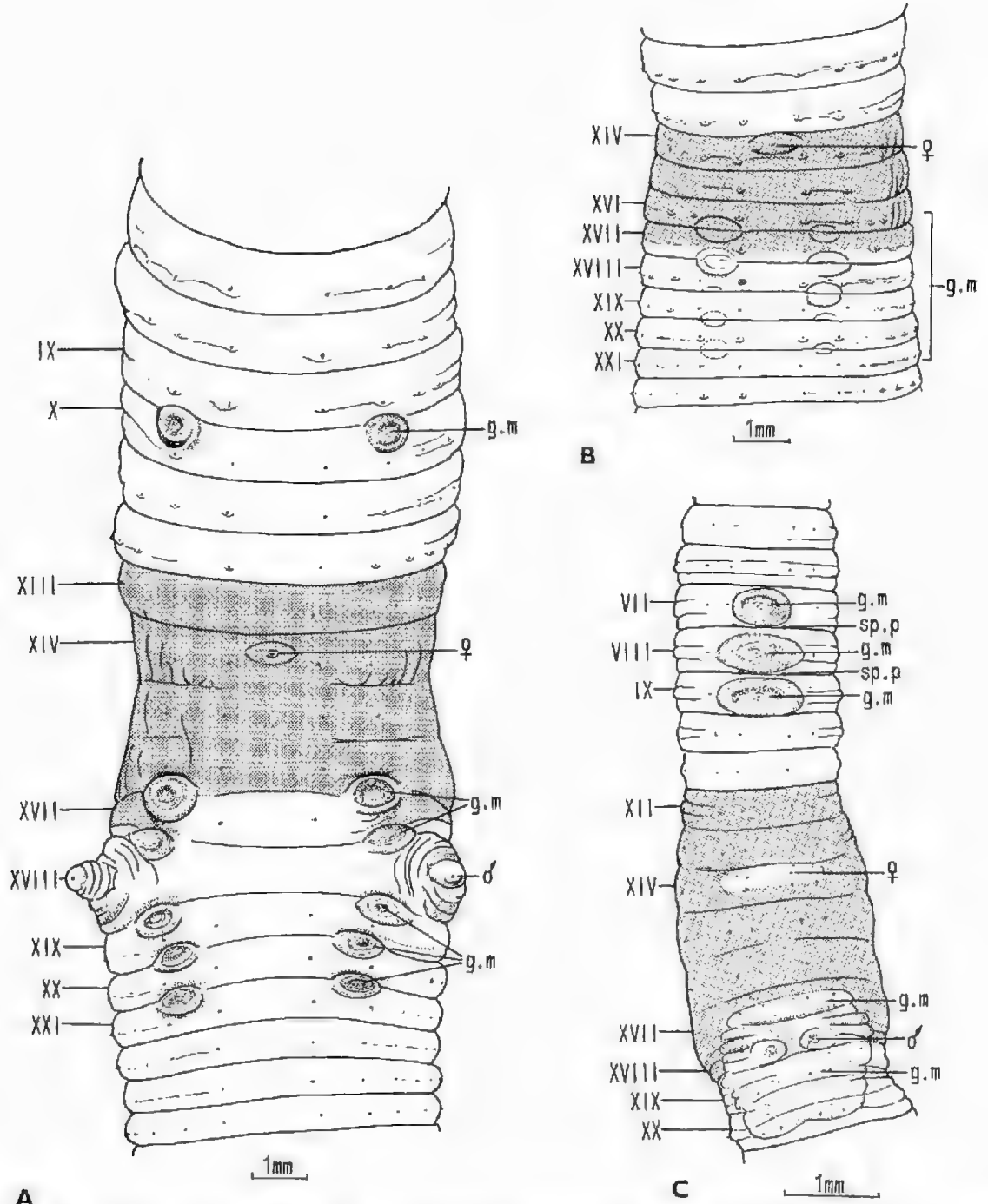


Fig. 6. Genital fields of: A & B, *G. octothecatus*, A, holotype, Lm1; B, paratype 1, L11. C, *Perionychella (P.) inconstans*, holotype, Mj1.

spermathecal pores. *G. similis* differs from *G. octothecatus* in the smaller number of spermathecal pores, restriction of accessory genital markings to X, 16/17 and 18/19, and the greater development of these markings. These differences of *G. octothecatus* from *G. dorsalis* and *G. similis* are minor compared with those between other species of the genus but union of the three entities in *G. dorsalis* nevertheless does not appear justified.

The prevalence of individuals lacking male terminalia suggests that *G. octothecatus* is commonly parthenogenetic.

Gemascolex similis sp. nov.

FIGS 3B, 10J, K; TABLE 8

Length = 40 mm + (posterior amputée), w (midclitellar) = 4.5 mm, s = 2. Pigmented, purplish brown, dorsally. Circular in cross section. Prostomium epilobous 1/3, closed. Preclitellar setae large, postclitellar indistinct, setae of a side more widely spaced dorsally and ventrally than between, decreasing in size dorsally; *ab* slightly wider than *bc* throughout. Numbers of setae per segment 18 in XII and XX, 20? (indistinct) in XXXV; *a* lines straight, *c* lines irregular throughout; a wide ventral break evident throughout; dorsal break wider and clearly visible anterior to the clitellum, poorly defined behind it owing to minuteness and irregularity of the setae; *a* and *b* absent in XVIII, *c* and *d* faintly visible on the lateral face of the porophore.

Clitellum rudimentary, apparently occupying XIV-1/2 XVII (= 3 1/2 segments), not sufficiently developed to obscure dorsal pores, intersegments or setae. Male pores minute, on stump-like, annulated pseudopenes, median to *c* of XVIII; a basal circumferential groove around each pseudopenis may represent the margins of male pore before eversion of the pseudopenis, this basal groove is itself borne on a large annulated porophore; the centres of the bases of the pseudopenes 4.8 mm, 0.33 circumference, apart. Accessory genital markings, paired subcircular, buttonlike, sharply demarcated lumescences, each differentiated into a peripheral rim and flat or depressed central area, filling the presetal part of X in *b*; in 16/17 and 17/18 in *ab*, filling the space between the setal arcs of the adjacent segments, those in 16/17 more median than those in 17/18. Female pore unpaired, midventral in XIV, presetal in an elliptical field. Spermathecal pores 3 pairs, in 6/7, 7/8 and 8/9, inconspicuous whitish ellipses, in setal lines 5-6,

TABLE 8
Intersetal distances in *Gemascolex similis*

Segmental XII Holotype Interval/ab	mm				standardized as % of circumference			
	aa	ab	xy	yz	u	ua	uh	yz
	1.7	0.9	0.9	3.0	14.0	72.1	6.2	6.4
						2.0	1.0	1.1
								13.9
								2.3

4-5 and 5-6 respectively (right side, not certainly visible externally on left side); 9 mm, 0.54 circumference apart, i.e. slightly dorsal.

Strongest septa 10/11 and 11/12, very strong; 8/9, 9/10, 12/13 and 13/14 also strong. Last hearts in XIII. Supra-oesophageal vessel in IX-1/2 XII; moderately developed. Gizzard in VI. Intestinal origin XVII, a very low ridgelike dorsal typhlosole commencing in approximately XVIII. Nephridia: paired tufts in II-V, increasing posteriorly from small to large; those in II and III discharging exonephrically anteriorly in their respective segments; those in IV apparently, but not certainly, discharging into the pharynx; those in V each with a wide composite (multiple) duct running anteromedially to the pharynx wall in III. Numerous exonephric micromeronephridia mostly in posterior bands in their segments in VI-XII; mostly presetal in XIII; anterior and posterior bands of micromeronephridia in XIV-XXI; thereafter mostly anterior in each segment; no nephrostomes present but posterior end missing behind the 40th segment. Sperm funnels iridescent in X and XI; seminal vesicles saccular, in XI and XII; a pair of small sacs on the anterior wall of X resemble seminal vesicles but in this location presumably do not have a seminal function. Ovaries with several chains of large oocytes, small flattened sacs on each side of them; ovisacs absent. Prostates large flattened lobes, with irregular, lobed, moderately deeply incised margins, restricted to but greatly enlarging XVIII; the tortuous muscular duct gradually but considerably widening through its length to the pore. Large intracoelomic glandular masses are associated with the accessory genital markings. Spermathecae 3 pairs, approximately uniform in size; diverticulum (inseminated) single, digitiform, but that of the left spermatheca of IX with a trilobulate terminal dilatation.

Material examined: LI2, 140°32'E, 37°41'S, 17 km SE of Millicent on road to Mt. Gambier, in sandy soil with grass, bracken and *Drosera*, fringing a *Pinus radiata* plantation, T.W., 15.viii.1972—H (AM).

Remarks: *G. similis* belongs to a *G. dorsalis* complex including also *G. octothecatus*. It

differs from both the latter species in having only 3 pairs of spermathecae. Its accessory genital markings have the same distribution as in *G. dorsalis*, though better developed, but it differs from this species in the unpaired female pore and absence of seminal vesicles from IX, in addition to the smaller number of spermathecae and their more ventral location relative to setal lines. Differences between the three species are minor relative to those between most other species of the genus but union of the three entities under *G. dorsalis* at present appears unjustified.

***Gemascolex stirlingi* (Fletcher, 1888a)**

FIGS 8A, B, 10L, 11G; TABLE 9

Perichacta stirlingi Fletcher, 1888a; 395-398; 1889b; 1017-1019.

Megascolex stirlingi Beddard, 1895: 373. Michaelsen, 1900: 222. Jamieson, 1971b: 95. Edmonds & Jamieson, 1973: 23.

Megascolex fletcheri Shannan, 1920: 301-313, Pl. XXVII-XXXI.

[non] *Megascolex fletcheri* Michaelsen, 1907b: 21.

Length — 300 mm, w (midlittellar) = 12 mm, s = 258 (Specimen 1. Specimen 2 is a posterior amputee). Pigmented dark olive-brown dorsally. Circular in cross section. Prostomium deeply bisected by a dorsal canalicula, epilobous 1/2, closed, but peristomium with numerous longitudinal furrows all round so that prostomium might be considered epitanylobous; transverse furrows render peristomium and prostomium mammillate. First dorsal pore 4/5 with, in specimen 1, an imperforate rudiment at 3/4. Setae well developed ventrally to midlaterally, rudimentary further dorsally; *aa* = *ab* but setae progressively more closely spaced dorsally. Numbers of setae per segment not or only approximately countable, 22 in XII, 20 fifteen segments from the caudal end in specimen 1; *a* lines straight, *z* lines irregular, a wide ventral and wider dorsal break in the setal circlelet present throughout. Setae *a*, *b* and *c* absent in XVIII. Few intersetal distances measurable.

Ciliellum XIV-XVII (= 4 segments). Male pores transverse slits with low but tumid lips, shortly median of setal lines *c* of XVIII, the pores 6.43-6.71 mm, 0.20-0.21 circumference apart (specimens 1 and 2); each low porophore lying in a depression and accompanied laterally by a raised slightly larger transverse ridge; the border of the segment immediately in front of and behind the pore also thickened to form a narrow callosity (specimens 1 and 2) or a small intersegmental tubercle present

TABLE 9
Intersetal distances in *Gemascolex stirlingi*

	aa	mm ab	ll	standardized as % of cir- cumference ae	
Segment XII					
Specimen 1	2.0	1.2	28.0	7.1	4.3
Specimen 2	1.9	1.1	28.0	6.6	4.1
Mean				6.9	4.2
Interval/ab				1.6	1.0
Segment XX					
Specimen 1	2.6	1.2	35.0	7.3	3.5
Specimen 2	2.3	1.1	35.0	6.5	3.3
Mean				6.9	3.4
Interval/ab				2.1	1.0

in front of and behind each pore at 17/18 (specimen 3). Paired eyelike accessory genital markings in 16/17, centred in *ab* nearer *b*, and in 19/20-22/23 (specimens 1-3), those in 19/20 centred slightly median of *c*, those in 22/23 slightly lateral of *c* (specimens 1 and 2) or those in 19/20-22/23 all in *bc* (specimen 3); the markings with raised whitish central area.

Paired postsetal oval genital markings with porelike centres immediately in front of and slightly lateral of but contiguous with the spermathecal pores, in VI, VII and VIII (specimens 2 and 3). Spermathecal pores 3 pairs, in 6/7, 7/8 and 8/9, large pores with wide lips forming an ellipse, in the 5th to 7th setal line; the pores, at 8/9, 13.57-14.43 mm, 0.44-0.45 circumference apart (specimen 1 and 2).

Strongest septa 9/10-12/13, very thick. Last hearts in XIII. Supra-oesophageal 1/2 VIII-XIII, well developed. Gizzard in VI. Intestinal origin XVII; typhlosole rudimentary, a slight thickening of the roof of the intestine middorsally, first discernible in XXVI. Nephridia: paired tufts with composite (multiple) ducts in II, III, IV and V, all large but increasing in size posteriorly, those in V very large; the tufts in IV and V open into the pharynx; the ducts of those in III apparently join the buccal cavity though some ducts open at intersegment 1/2; whereas those in II appear all to be exonephric in the vicinity of 1/2 (specimens 1 and 2). Dense lateral bands of numerous (exonephric?) micromeronephridia lie in VI-XI on the parietes at the posterior septum; in XII-XIX nephridia are anterior as well as posterior in the segment, being especially dense in XIII-XVI; in XX posteriorly they are anterior only in the segment. Caudally with numerous large meronephridia on each side, adherent to the posterior faces of the septa on the intestine and body wall, each with a large single preseptal funnel which

has a long inflated neck, the nephridial ducts difficult to trace but apparently (all?) opening into the intestine (specimen 1).

Sperm funnels iridescent in X and XI. Seminal vesicles racemose, in XI and XII; a further pair of similar but smaller sacs on the anterior septum of XIII (specimens 1 and 2) median to the ovaries (1) or separate ovaries not developed (2). Ovaries consisting of many attenuated chains of large oocytes (specimen 1). Large sacs on the anterior septum of XIV may be ovisacs but show no loculi (specimens 1 and 2). Prostatae tongue-shaped, lobulated and incised, restricted to XVIII, the glandular part passing directly laterally, with slit-like central lumen the greatest width of which is only about one tenth the width of the gland, i.e. gland tubuloracemose; the muscular duct S-shaped, with an abrupt bursa-like terminal dilatation. White paired glandular masses in each of segments XVII, XIX–XXIII, corresponding with the external genital markings, large with the exception of those in XIX which correspond with the rudimentary markings in 18/19. Similar paired masses on the

body wall in VI, VII and VIII in line with the spermathecal ducts; and corresponding with the external genital markings. Spermathecae 3 pairs, in VII, VIII and IX, increasing in size posteriorly; diverticulum (inseminated) single, clavate, uniloculate (specimens 1 and 2).

Field variation: Specimens 1–4 have a circular genital marking anterolateral to each spermathecal pore (with sporadic omissions) whereas in specimen 5 the marking is posterolateral, in the succeeding segment. Genital markings at 16/17, at or near 17/18 and 18/19, and in 19/20–22/23 are constant in all specimens and are paired with the exception that that on the left in 22/23 is absent in specimen 3.

Material examined: Ig1, 138°03'E, 32°46'S, Alligator Gorge National Park, under rocks near creek in gorge, B.J. and T.W., 19.viii.1972—specimens 1 and 2. Jg2, 138°10'E, 32°48'S, Mt. Remarkable, under moss in soil pocket in scree on mountain side, B.J., 17.viii.1972—specimen 3. Jh1,

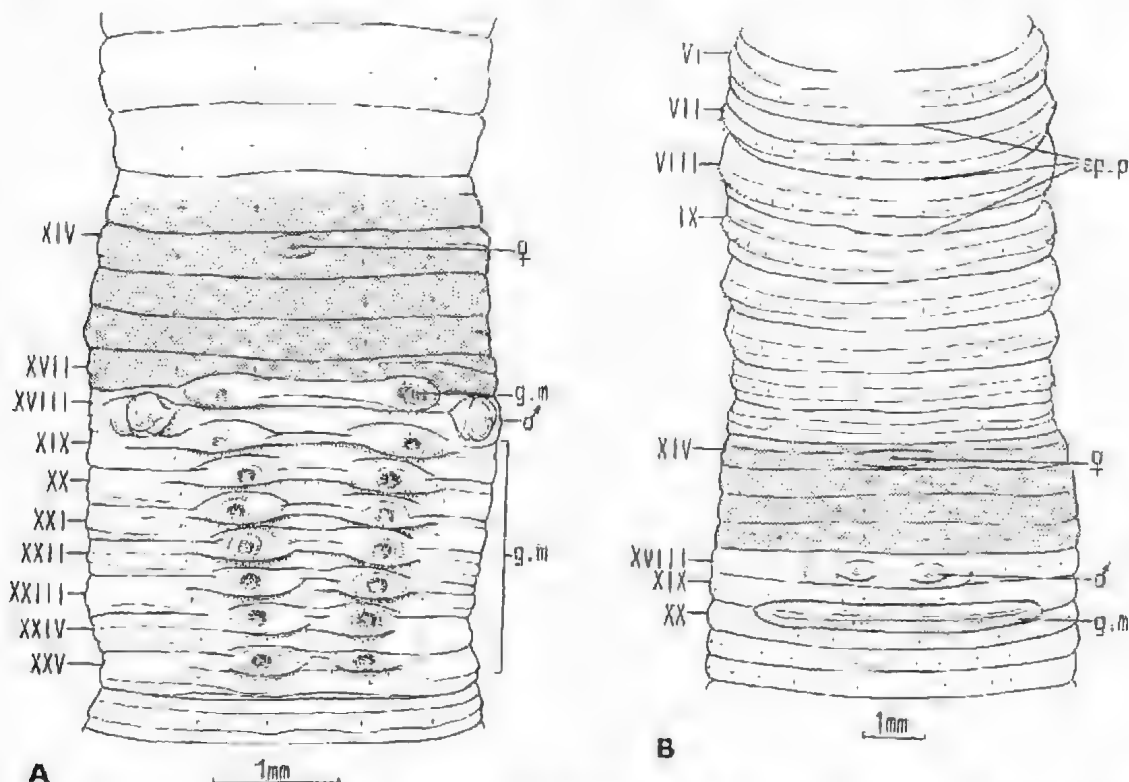


Fig. 7. Genital fields of: A, *Gemascolex walkeri*, holotype, Jh1. B, *G. newmani*, Warren Gorge specimen.

138°18'E, 33°05'S, 21 km from Gladstone along road to Port Augusta, in red loam among red gums by road, *B.J.* and *T.W.*, 18.viii.1972—specimen 4. J12, 138°42'E, 35°00'S, Craters, near Adelaide, *R.A.*, 24.xi.1971—specimen 5. Specimen 1 (*BM*), specimen 3 (*AM*), specimen 2 (*SAM*), specimen 4 and 5 (*BJ*).

Remarks: Location of the genital markings in 16/17 median to the male pores, while those in 17/18–22/23 are approximately in line with these pores, permits ready identification of *G. stirlingi*.

Gemasclex walkeri sp. nov.

FIGS 7A, 10M, 11H; TABLE 10

Length = 42 mm, *w* (midclitellar) = 3 mm, *s* = 107, 111 (*H*, *P1*). Pigmentless in alcohol. Circular in cross section. Prostomium epitanylobous, posteriorly convergent, narrow. First dorsal pore 4/5. Setae *ab* and *bc* wide throughout and approximately equal, being slightly wider than other intersetal distances of a side anterior to the clitellum; posterior to the clitellum *ab* and *bc* remain the largest intervals but spacing of other setae becomes very irregular. Numbers of setae per segment 14 in XII and XX (*H*, *P1*), 18(*P1*)–22(*H*) fifteen segments from the caudal end; *a* lines straight throughout; *z* lines straight in the forebody, irregular in the hindbody; *a* moderately wide ventral break visible throughout; *a* dorsal break discernible in the forebody but not present in the hindbody. Setae *a* and *b* absent in XVIII.

Clitellum rudimentary, some annular modification on XIV–XVI. Male pores on hemispheroidal porophores in XVIII; the pores 2.29(*P1*)–2.78(*H*) mm, 0.30(*P1*)–0.34(*H*) circumference apart. Paired cyclike ventrally conjoined genital markings in intersegments 17/18–24/25, converging posteriorly from *ab* in 17/18 to *a* in 24/25 (*H*, see Field Variation). Spermathecal pores 1 pair, ventral in 5/6, small elliptical papillae in setal lines *c*; 2.43(*H*)–2.64(*P1*) mm, 0.34(*P1*)–0.38 circumference, apart. Strongest septa 10/11 and 11/12, moderately strong. Last hearts in XIII. Supra-oesophageal traced in IX–XIII. Gizzard in V. Intestinal origin XVII; a deep laminar dorsal typhlosome commencing in XXI or XXII but continuous as a rudiment forward into XVIII. Nephridia: Paired metanephric tufts in II, III, IV and V with composite ducts opening into the pharynx; very large in V, decreasing in size anteriorly (*H*, *P1*). Transverse bands of numerous astomate, micromero-

TABLE 10
Intersetal distances in *Gemasclex walkeri*

	mm				standardized as % of circumference			
	aa	ab	ap	az	aa	ab	ap	az
Segment XII								
Holotype	0.8	0.6	0.6	0.7	7.7	10.5	7.9	9.1
Paratype 1	0.6	0.5	0.5	0.8	7.6	10.7	6.1	10.7
Mean						10.6	7.4	9.9
Interval/ab						1.4	1.0	1.3
Segment XX								
Holotype	0.8	0.7	0.7	0.6	8.0	10.1	8.4	7.9
Paratype 1	0.8	0.6	0.6	0.8	7.9	9.8	7.6	9.8
Mean						10.0	8.0	8.8
Interval/ab						1.2	1.0	1.0

nephridia exonephric on the body wall in VI–VIII; associated in IX–XV with the posterior septa, in XVI with the anterior and posterior septa, and in XVII and succeeding segments with the anterior septa; all septal nephridia lacking detectable parietal ducts (enteronephric?) (*H*). Caudally, from about segment 70, with fewer, larger nephridia, approximately 5 on each side, each with a preseptal tunnel, the nephridial ducts running on the posterior face of the septum to join the ventrolateral wall of the intestine, some suggestion of a longitudinal duct joining those of adjacent segments seen on the side of the gut but requiring confirmation; postseptal nephrostomes absent; some astomate, parietal and apparently exonephric micromeronephridia present in caudal segments in addition to the stomate nephridia (*H*, *P1*). Sperm funnels weakly iridescent in X and XI; seminal vesicles racemose, almost sacciform, in XI and XII. Ovaries bushy with several strings of large oocytes; small sacs in XIV may be ovisacs. Prostates flattened, leaflike, with deeply incised margins and a groove-like 'midrib', restricted to XVIII; duct U-shaped, bent medianwards, the ectal limb greatly thickened; vas deferens joining the ental limb at midlength. Spermathecae one pair, in VI, diverticulum (uninseminated) single, digitiform, uniloculate, slightly longer than the ampulla (*H*, *P1*). **Field variation:** In the sexual, though imperfectly clitellate types (holotype and 4 paratypes), genital markings are consistently present in the seven intersegments 17/18–23/24 but those in 20/21–23/24 may be sporadically absent unilaterally. Only *P1* agrees with the holotype in having a marking (unilateral, right) in 24/25.

Material examined: J11, 138°38'E, 35°00'S, Belair National Park, dry grass and eucalypt sclerophyll, *T.W.*, 21.viii.1972—*H*, *P1*–4. J12, 138°42'E, 34°58'S, Mt. Lofly, in eucalypt woodland, *B.J.* and *T.W.*,

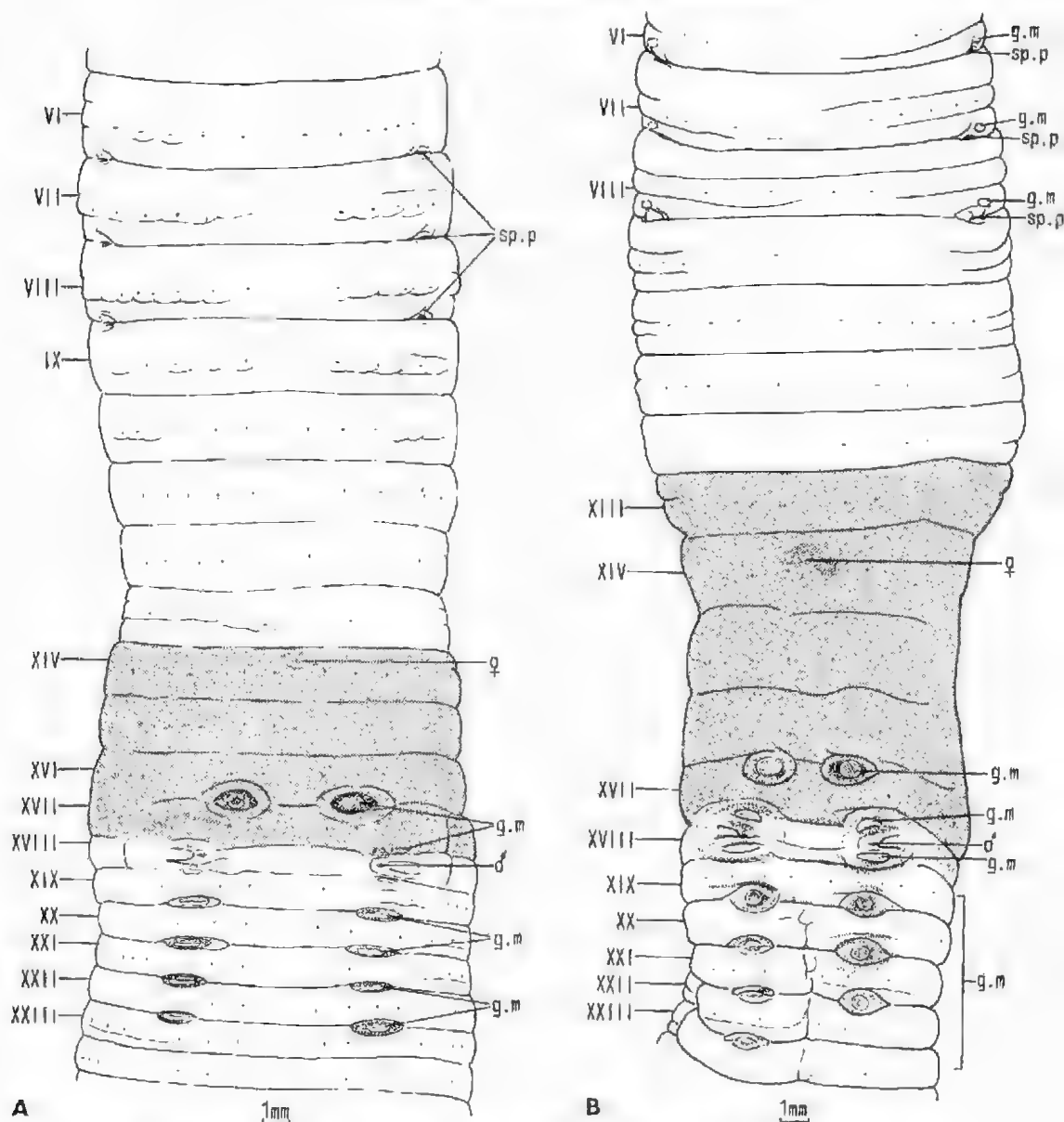


Fig. 8. *Gemascolex stirlingi*. Genital fields of: A, specimen 1, Jg1. B, specimen 3, Jg2.

16.viii.1972—P5 and 6. H, P2 (AM); P1, P3 (BM); P4 (SAM); P5 and 6 (BJ).

Remarks: The single pair of spermathecae, restricted to VI, distinguishes this species.

Genus *SPENCERIELLA* Michaelsen, 1907a emend.

Terrestrial. Body circular in cross section. Prostomium epilobous; peristomium usually bisected by a longitudinal furrow ventrally which is more conspicuous than other grooving which may be present. First dorsal pore 4/5

or 5/6. Setae numerous in each segment. A pair of combined male and prostatic pores on XVIII. Clitellum annular, anterior to 17/18. Its intersegments and dorsal pores obscured at maturity but setae visible. Segmental accessory genital markings present. Female pores paired, in XIV, anteromedian of setae *a*. Spermathecal pores in 2-5 intersegments ending in 8/9, or a pair in 7/8 only; single or paired.

Dorsal blood vessel single, continuous onto the pharynx. Last hearts in XII or XIII, those in X posteriorly latero-oesophageal, each aris-

ing from the short supra-oesophageal vessel and from the dorsal vessel. Subneural vessel absent. Gizzard large, in V. Three or four pairs of well-defined extramural glands, typically with many internal septa, dorsolateral on the oesophagus, in X, XI–XIII. Typically with a latero-oesophageal vessel on each side supplying the calciferous glands. Intestine commencing in XV or XVI or (*S. halli*) XVII; typhlosolæ a low dorsal ridge or absent; caeca and muscular thickening absent. Excretory system meronephric. Pharyngeal tufts present anteriorly; succeeding segments with astomate, exonephric micromeronephridia. Caudally (always?) with several nephrostomes on each side in each segment or with all but the median-most funnel reduced; with (always?) some at least of the meronephridia enteronephric and interconnected by a longitudinal paired excretory duct (ureter). Testes and funnels in X and XI; testis-sacs absent; seminal vesicles in IX and XII.

Ovaries and funnels in XIII; ovisacs present. Prostates tubuloracemose (partly or wholly linear with central lumen) or racemose (here bipartite); vasa deferentia joining their muscular ducts near the glands. Spermathecae each with one or more clavate, uniloculate diverticula.

Type-species: *Diporochaeta notabilis* Spencer, 1900

Distribution: South Australia, Victoria and Tasmania, New Zealand?

CHECKLIST OF SPECIES

* New combinations in *Spenceriella*.

South Australia:

1. *Spenceriella imparicystis* sp. nov.
2. *Spenceriella penolaensis* sp. nov.

Victoria:

3. *Perichaeta frenchi** Spencer, 1892
4. *Perichaeta halli** Spencer, 1892
5. *Perichaeta hoggi** Spencer, 1892
6. *Diporochaeta notabilis* Spencer, 1900
7. *Perichaeta rubra** Spencer, 1892
8. *Perichaeta steeli** Spencer, 1892
9. *Perichaeta sylvatica** Spencer, 1892

Tasmania:

10. *Perichaeta tasmanica** Spencer, 1895

Species incertae sedis:

11. *Megascolex antarctica* Baird, 1871
syn. *Diporochaeta shakespear* Benham,
1906 (New Zealand)

12. *Spenceriella argillae* Lee, 1959 (New Zealand)
13. *Diporochaeta gigantea* Benham, 1906 (New Zealand)
14. *Diporochaeta nuplestoni* Spencer, 1900 (Victoria)
15. *Spenceriella pallida* Lee, 1959 (New Zealand)

Remarks: Jamieson (1972) described a neotypic specimen of the type-species, *Spenceriella notabilis*. The specimen was in very poor condition and it was only possible to say of the several rows of meronephridia that a preseptal funnel was seen in one segment on the nephridium nearest the nerve cord. This suggested membership in the tribe Dichogastrini, a group characterized by a single preseptal funnel on the medianmost nephridium on each side in caudal segments. Three other species, of which material has been examined by the author, are clearly congeneric with *Spenceriella notabilis* from their general morphology and particularly from the form and arrangement of extramural calciferous glands. These are the two new species *S. imparicystis* and *S. penolaensis* and a species provisionally placed in *Megascolex* by Jamieson, 1974, *Perichaeta tasmanica* Spencer, 1895. The two South Australian species have multiple caudal nephrostomes with enteronephry and therefore show that *Spenceriella* must be consigned to the tribe Megascolecini. Only the median funnel on each side was identified with certainty in the new material of *P. tasmanica* but what appeared to be vestigial funnels were present laterally to this and caudal enteronephry was demonstrated for the median nephridium. This suggests a secondary approach to the dichogastrin condition in this species. The other species included above in *Spenceriella* agree closely with the three studied in general morphology, including the arrangement of calciferous glands, though details of excretory and vascular systems are unknown. Occurrence in one and the same genus of linear tubuloracemose or bipartite prostates with branched ducts, further confirms the author's contention (Jamieson 1971a) that the form of prostate glands has only very secondary importance in the classification of megascolecids, contrary to the view of Gates (1959).

Other species included by former workers in *Spenceriella* are listed by Jamieson (1972: 73). Of these *Perichaeta lateralis*, tentatively included by Michaelsen 1907a, is here placed in *Gemascolex*. The remaining species pre-

viously included are treated above as *incertae sedis* because, though not placeable in *Spenceriella* as homogeneously defined above, they are not at present placeable elsewhere without premature erection of new genera for their reception. *Megascolex antarctica* placed, as *Diporochaeta shakespearei*, in *Spenceriella* by Michaelsen (1907a) deserves separate comment. From his, albeit inadequate descriptions this conforms sufficiently closely with the above generic definition (including calciferous glands in XI-XIII) to conceivably be congeneric with *Spenceriella notabilis* but little is known of its nephridia beyond the existence of hands of metanephridia. Its peregrine distribution in New Zealand and its islands makes an Australian origin of this species or an ancestor conceivable.

Spenceriella imparicystis sp. nov.

FIGS 9A, 10N; TABLE 11

Length = 44(H)–45(P1) mm, w (mid-clitellar) = 2.8 mm, s = 107(P1)–122(H). Pigmentless in alcohol. Prostomium not canaliculate, epilobous 1/2(H)–2/3(P1) open but with two weak transverse furrows anterior to its posterior limit. First dorsal pore 4/5, but an imperforate rudiment at 3/4. Setae subequally spaced: 24 in XII, 22(H)–23(P1) in XX, 22 caudally; α lines straight, γ lines irregular; a ventral break appreciable throughout; a dorsal break present only in some anterior segments. Setae α and b absent in XVIII.

Clitellum weakly developed, 1/2 XIII–XVII (4 1/2 segments), dorsal pores, intersegments and setae retained (H: not developed in P1). Male pores quadriradiate apertures in ab of XVIII, each at the centre of an oval papilla in a very strongly protuberant paired porophore which fills the segment longitudinally and is wider than long; each porophore almost touching the other; the pores 0.77 (P1)–0.88 mm (H), 0.1 circumference apart. Accessory genital markings paired midventrally conjoined tumescences filling their segments longitudinally and with presetal pore-like centres lateral of b in X, and in ab in XVII and XIX. A pair of small glandular areas present posteriorly in each of VII and VIII on each side of the spermathecal pore of the segment, on a midventral elliptical tumescence straddling 7/8 and 8/9 (H, P1; see Field Variation). Spermathecal pores unpaired, midventral, in 7/8 and 8/9, each continued anteriorly as a short slit bisecting the posterior part of the surrounding tumescence.

TABLE 11

Intersegmental distances in *Spenceriella imparicystis*

	aa	ab	mm		u	standardized as % of circumference			
			xy	yz		aa	ab	xy	yz
Segment XII									
Holotype	0.7	0.3	0.3	0.4	7.8	9.5	3.5	4.2	5.0
Paratype I	0.7	0.2	0.3	0.4	7.4	9.5	3.1	3.8	5.4
Mean						9.5	3.3	4.0	5.2
Interval/ab						2.9	1.0	1.2	1.6
Segment XX									
Holotype	0.7	0.1	0.2	0.3	9.9	7.0	2.5	2.0	2.3
Paratype I	0.6	0.2	0.3	0.3	8.0	7.9	2.9	1.4	1.1
Mean						7.4	2.7	2.7	2.8
Interval/ab						2.7	1.0	1.0	1.0

Strongest septa 9/10–11/12, moderately strong. Last hearts in XII; those in X–XII latero-oesophageal, each originating from a transverse vessel (calciferous vessel) which bounds, and ramifies over the corresponding calciferous gland and receiving (observation from one heart) at its junction with this vessel, a slender connective from the dorsal blood vessel; a continuous supra-oesophageal vessel not demonstrable; the two calciferous vessels on each side in a segment join in the midline below the dorsal vessel, at the dorsal extremities of the glands high above the oesophagus. Commissurals in VII–IX well developed but dorsoventral only and, unlike the latero-oesophageal hearts, giving ventrally branches to the parietes. A latero-oesophageal vessel present on each side median to the hearts, thickest in front of the calciferous glands to each of which it contributes a branch, becoming suboesophageal and subpharyngeal in front of the gizzard.

Gizzard large, with anterior rim, firmly muscular in V, extending posteriorly to intersegment 10/11; free oesophagus in IV not as wide as the gizzard. Oesophagus only slightly shorter in VI than further posteriorly; conspicuously vascularized, moniliform but fairly narrow in VIII and IX; in each of X, XI, XII and XIII bearing a pair of ovoid vertically elongated true calciferous glands, the short narrow stalks of which join the dorsolateral wall of the oesophagus, the glands lying above the oesophagus and each contiguous with its partner medianly; each gland with numerous lamellae projecting from the walls and grouped radially around the long (vertical) axis of the gland, almost contiguous axially but no union demonstrated; each gland, with the exception of the pair in XIII, circumscribed on its outer side by the corresponding heart. Intestinal origin XVI; a very low, indefinite dorsal ridge commencing in XVII, scarcely justifying recognition as a typhlosole; muscular thickening and

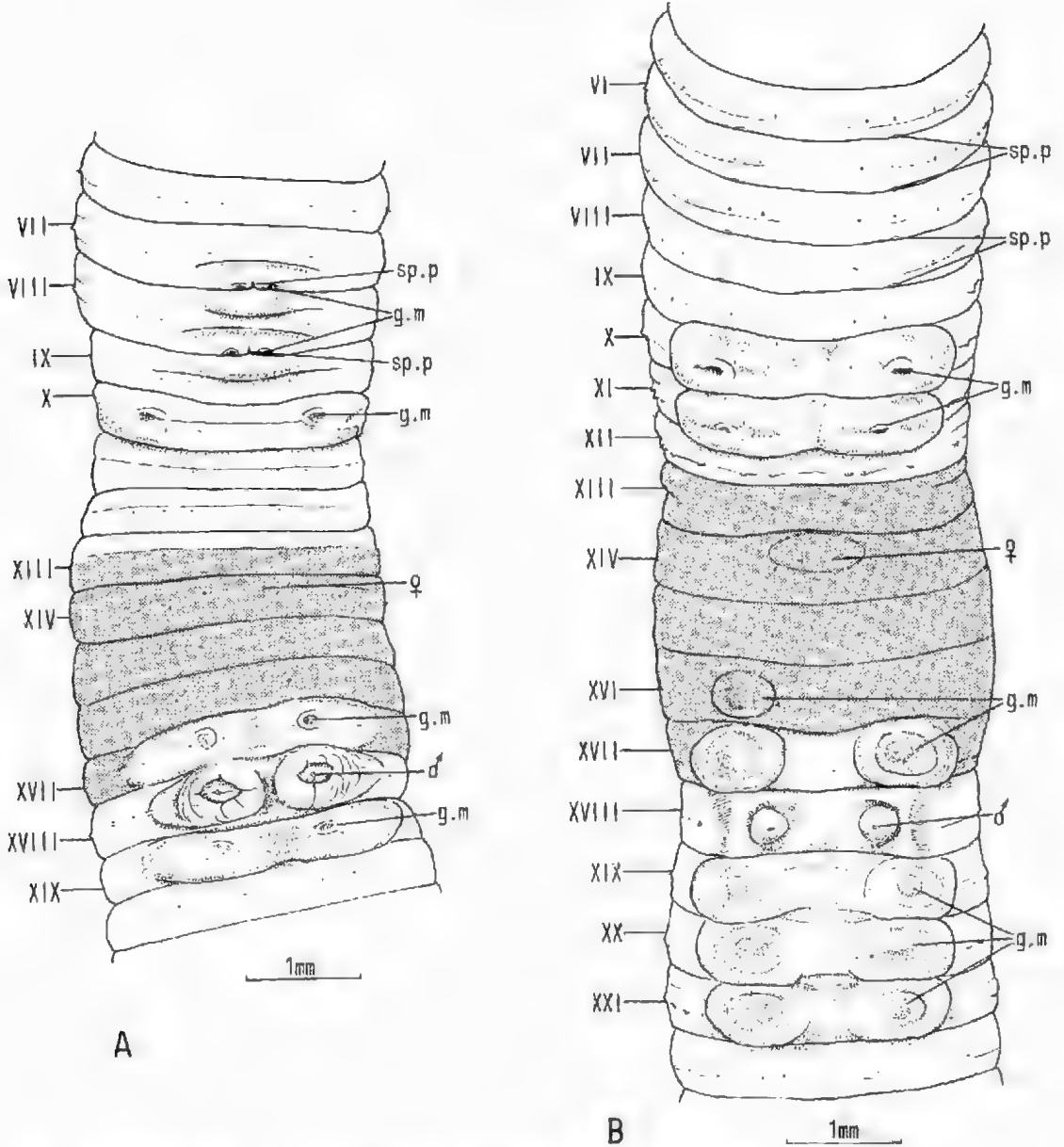


Fig. 9. Genital fields of: *A. Spenceriella imparicystis*, holotype, I.k.4. *B. S. penolaensis* holotype, L.m.1.

caeca absent. Nephridia: a pair of very large tufts with innumerable spiral loops in V sends composite ducts anteriorly to join the wall of the anterior region of the pharynx (enteronephric); much smaller tufts in IV are not certainly exonephric; while aggregations of nephridial tubules in II and III are exonephric, via sheaves of ducts, at the anterior margins of their respective segments. In the anterior intestinal region with numerous parietal asto-

mate, exonephric, micromeronephridia. Caudally with several enlarged nephridia on each side, each with a single (presseptal?) funnel. Lateral nephridia exonephric; more median nephridia contributing their ducts to a common transverse medianly directed duct which joins the dorsal surface of the intestine shortly lateral of the dorsal blood vessel; a longitudinal duct which apparently connects these segmental nephridial ducts visible running through

some caudal segments (H, P1). Sperm funnels iridescent in X and XI. Ovaries slender, pinnate, with large oocytes. True ovisacs containing oocytes in XIV. Prostates with a flattened laterally directed tongue like portion in XVIII which is joined at approximately mid length by a tortuous, depressed almost tubular portion in XIX, the entire gland not linear but having the appearance of derivation from a tortuous depressed tubular gland in which some adjacent adpressed coils have united; vas deferens joining the straight muscular duct where this joins the gland; Spermathecae unpaired, midventral, in VIII and IX; each with 2 (inseminated?) clavate uniloculate diverticula, the two diverticula projecting on both sides of the ventral nerve cord and one of them passing under it to join the wide spermathecal duct where this enters the body wall (H, P1).

Field variation: In the four type-specimens the accessory genital fields are constant, with the exception that the paired markings in X are absent in paratype 2; probably owing to immaturity. Two immature specimens, not designated types, from locality L12 have genital fields and an internal anatomy which suggests they belong to this species but all genital markings are slightly more median than in the types. The median markings at 7/8 and 8/9 are absent but spermathecae are unpaired midventral at 7/8 and 8/9, the paired segmental markings in X have centres presetal in *ab*; those in XVII are absent but there is a pair in each of XIX and XX presetally and slightly median of *a*; the male pores are median to *a* lines.

Material examined: Lk4, 140°44'E, 36°59'S, 1.6 km S of Naracoorte, in sandy soil with bracken and wattles near pasture, B.J. and T.W., 16.viii.1972—H, P1-3. L12, 16 km SE of Millicent on road to Mount Gambier, in black soil under mallee gums, B.J. and T.W., 15.viii.1972—2 semi-mature specimens not designated types. H (AM): P1-2 (BM); P3 and L12 (BF).

Remarks: *Spenceriella imparicystis* is morphologically very similar to the type-species *S. notabilis* (see Jamieson 1972), the genital fields in the specimens from locality L12 being especially similar. The similarity extends to location of latero-oesophageal hearts in X-XII with calciferous glands in X-XIII. The unpaired spermathecae in VIII and IX in *S. imparicystis* clearly distinguish it from *S. notabilis* which has a pair of spermathecae in VIII

only. The paired spermathecal diverticula are also distinctive. The distribution of calciferous glands and hearts distinguishes it, among other features, from *S. penolaensis*.

Spenceriella penolaensis sp. n.

FIGS 9B, 10 O; TABLE 12

Length = 43-54 mm, w (midclitellar) = 3 mm, s = 79-128 (H, posterior amputee?, P1). Pigmentless in alcohol. Prostomium canaliculate, epilobous 1/2, with transverse furrow at 1/4, the lateral grooves continuing almost to intersegment 1/2. Dorsal pores very large, the first at 4/5. Setae small and difficult to discern, subequally spaced but *bc* significantly wider than *ab*; *a* lines straight, *z* lines irregular; a ventral break well developed throughout, a dorsal break present except in some caudal segments. Intersetal distances in XX not measurable. Setae *a* and *b* absent in XVIII.

Clitellum XIII-XVII, but in XVII present only dorsal to the genital markings. Male pores in *ab* of XVIII, each a small orifice on an approximately hemispheroidal potophore which is laterally skirted by a tumid ridge; the pores 0.56(P1)-0.88(H) mm, 0.05(P1)-0.12(H) circumference apart but not accurately measurable as body wall is depressed between pores. Accessory genital markings all segmental, not intersegmental; a pair of large tumid whitish pads filling their segments longitudinally, each with central circular area distinct from a peripheral strongly tumid rim, extending laterally of *c* lines in X and XI, with centres slightly postsetal and lateral of *b* (H, P1), and in XVI (right only) (H), XVII, XIX, XX (H, P1) and XXI (paired) (H), with centres slightly presetal and lateral of *b*; most genital markings medianly conjoined (see Field Variation), Spermathecal pores 5 pairs, in 4/5-8/9, in *b* lines; scarcely recognizable externally; the pores 1.47 mm (H, P1), 0.15(P1)-0.16(H) circumference apart.

Strongest septa 9/10-11/12, moderately strong. Last hearts in XIII, those in X-XIII, each arising from a supra-oesophageal vessel (in X) or from a transverse vessel bounding

TABLE 12

Intersetal distances in *Spenceriella penolaensis*

Segment XII	mm.					standardized as % of circumference			
	aa	ab	bc	cd	u	aa	ab	bc	cd
Holotype	0.6	0.2	0.5	0.8	7.2	8.7	2.9	3.5	11.6
Paratype 1	0.7	0.2	0.5	0.7	11.0	6.1	1.7	2.8	6.3
Mean						7.4	2.3	3.1	8.9
Interval/ab						3.2	1.0	1.4	3.9

the corresponding calciferous gland (in XI–XIII) and receiving a long slender connective from the dorsal blood vessel; otherwise unbranched. Commissurals of VI–IX dorsoventral only, slender though, like the posterior hearts, valvular, but differing from the latter in ventrally giving branches to the parietes. Supra-oesophageal vessel not demonstrable as a continuous vessel but seen in X and XIII.

Gizzard very large, ovoid but flattened at the anterior wider end, firmly muscular in V, (septum 5/6 exceedingly attenuated) its posterior end extending almost to intersegment 10/11. Oesophagus very short in VI–X but in each of XI, XII and XIII bearing a pair of ovoid vertically elongated true calciferous glands, the short narrow stalks of which join the dorsolateral wall of the oesophagus, the glands lying above the oesophagus and each contiguous with its partner medianly; each gland with numerous lamellae projecting from the walls and grouped radially around the long (vertical) axis of the gland, several uniting axially, the others almost contiguous but not uniting; each gland circumscribed on its outer side by the corresponding heart. Intestinal origin XVI; a low irregular dorsal typhlosote commencing in XXI; caeca and muscular thickening absent. Nephridia: astomate meronephridia in II loosely aggregated into tufts send sheaves of ducts dorsolaterally to intersegment 1/2; similar aggregations in III–V also appear to be exonephric, are adherent to the pharynx and are apparently at least partly enteronephric, what appear to be pharyngeal ducts being demonstrable in P1. Succeeding oesophageal and intestinal segments have each a transverse row of approximately 10 astomate parietal micromeronephridia on each side. Caudally (P1 and 2) with several small nephrostomes (one to a meronephridium) on each side in each segment, each funnel lying in the segment projecting from its nephridial body near its duct and not preseptal with the exception of the medianmost nephridium which, in some segments was seen to have a preseptal funnel. At least some of the nephridial ducts in each segment combine to send a duct to the dorsolateral surface of the intestine; these ducts communicating from segment to segment by a longitudinal duct on each side which runs on the external surface of the intestine of several segments where visible but is not demonstrable, and is therefore questionably continuous throughout the caudal region. Confinement of the exact arrangement of the

nephridia of this species is required as unusual difficulty in demonstrating the structures described precludes certainty that the pharyngeal and all caudal nephridia are enteronephric and actual openings of the caudal ducts into the intestinal lumen have not been demonstrated. Sperm funnels iridescent in X and XI. Ovaries bushy with many chains of very large oocytes (H, P1); ovisacs absent (H) or well developed, containing numerous oocytes, on the anterior septum of XIV (P1). Prostates tubuloracemose, lobulated but linear, the gland folded once and occupying XVIII and XIX, with very narrow central lumen throughout, surrounded by thick glandular walls; the curved muscular duct joined near its junction with the gland by the vas deferens. Penial setae, and internal glands corresponding with the accessory genital markings, absent. Spermathecae 5 pairs, diverticulum (inseminated) single, clavate, uniloculate.

Field variation: In the eleven type-specimens, including the holotype, paired genital markings with centres lateral to *h* and slightly postsetal are invariably present in X and XI; paired genital markings with centres lateral to *b* and slightly presetal are invariably present in XVII and XIX, occur in 6 specimens in XX (H, P1–3, 6, 10), and are represented, on the right only, in 2 specimens (H, P6). Female pores are always paired, presetal, 1/3–1/2 *aa* apart and spermathecal pores are never discernible with certainty externally.

Material examined: LH, 140°49'E, 37°28'S, 11 km S of Penola, in eucalypts fringing *Pinus radiata*, B.J. and T.W., 15.viii.1972—P7–10. Lm1, 140°55'E, 38°01'S, 26 km from Mr. Gambier along road to Nelson, in sandy loam under grass among wattles and gums with some herbaceous garden escapes. R.J. and T.W., 15.viii.1972—II, P1–6, H, P2–4 (AM); P1, 5, 6 (BM); P7–8 (SAM); P9, 10 (BJ).

Remarks: *S. penolaensis* is distinguished from the type-species, *S. notabilis*, and from *S. imparicystis*, in having only three pairs of calciferous glands, lacking those of X. It differs from both species in having five pairs of spermathecae and in other respects.

Discussion

The earthworm fauna of South Australia is remarkably impoverished, though of high specific endemicity. It has been shown above that the total known fauna in the only indigenous family, the Megascolecidae, con-

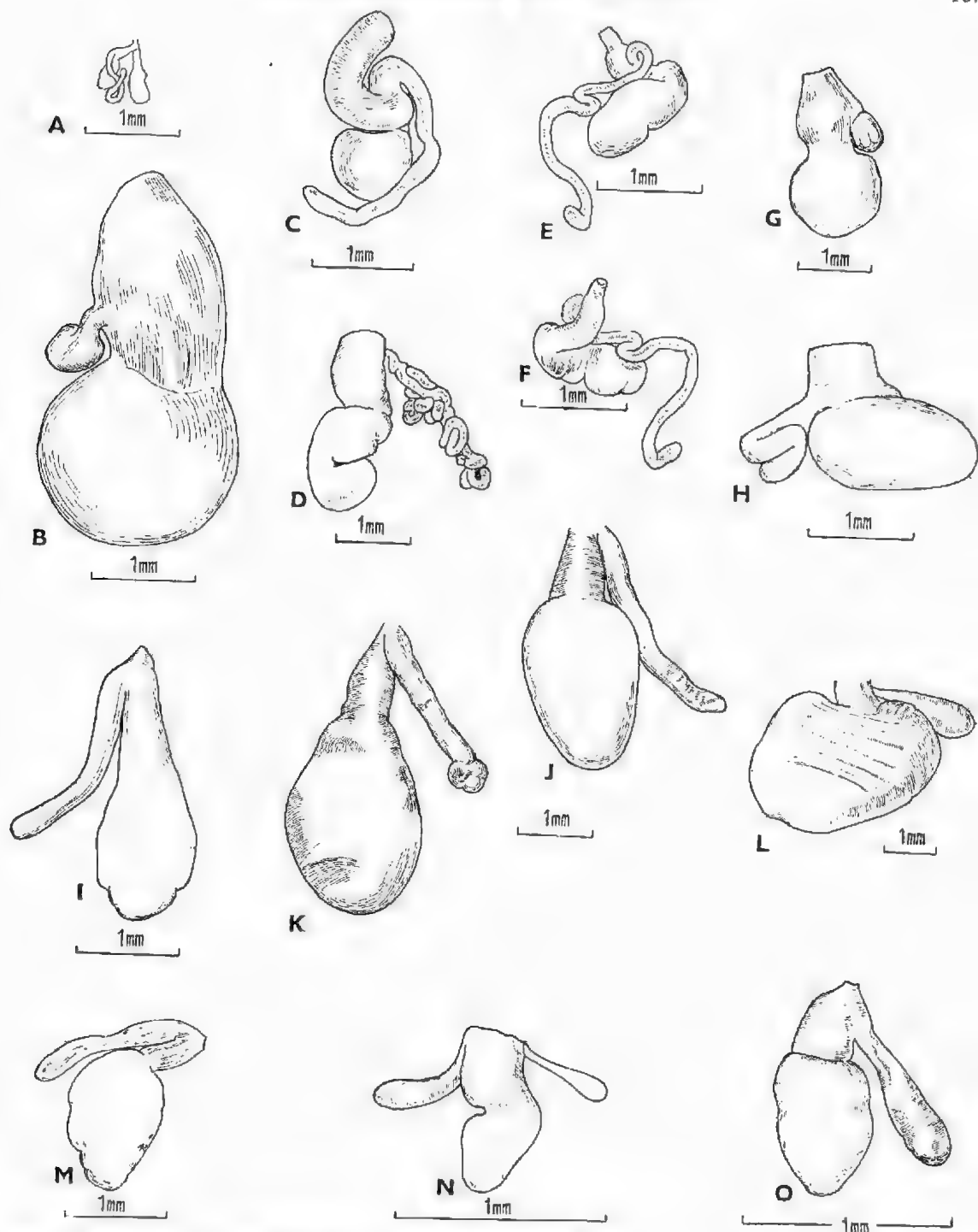


Fig. 10. Spermathecae (right segment IX unless otherwise indicated): A, *Perionychella* (*P.*) *inconstans*, holotype, Ij1. B, *Heteroporodrilus shephardi armatus*, LI1. C, *Gemascolex bursatus*, holotype, Jj3. D-F, *Gemascolex lateralis*; D, specimen 1, Ji2; E & F, specimen 3, LI1 (dorsal and ventral views, right VIII). G, *Gemascolex mirabilis*, holotype, Jg2. H & I, *Gemascolex octothecatus*; H, holotype, Lm1; I, paratype LI1. J & K, *Gemascolex similis*; holotype, LI2 (J, left VIII; K, left IX). L, *Gemascolex stirlingi*, specimen 1, Jg1 (left IX). M, *Gemascolex walkeri*, holotype, Ji1 (right VI). N, *Spenceriella imparicystis*, holotype, Tk4 (unpaired, IX). O, *Spenceriella penolaensis*, holotype, Lm1.

sists of a peregrine species of *Microscolex*, a single species questionably assignable to *Perionychella* (from Kangaroo Island), a subspecies of a Victorian species of *Heteropodrilus*, eight species of *Gemascolex* and two species of *Spenceriella*; in all, ignoring the peregrine *Microscolex*, four genera with twelve species in contrast with thirteen genera with seventy eight species in neighbouring Victoria and twelve genera with forty eight species in the small island state of Tasmania. All of its genera and two species are shared with Victoria. South Australia therefore has close zoogeographic affinities with Eastern Australia. Apart from the fact that the Kangaroo Island *Perionychella* shows affinities with the genus *Gnathiophilus* in Western Australia, there are no generic or specific affinities with the latter state.

The paucity of the fauna of South Australia is correlated with its low rainfall. A south-eastern coastal wedge, the Fleurieu and Yorke Peninsulas and Kangaroo Island are the wettest parts, with an annual rainfall, with local exceptions, of between 500–750 mm (20–30 inches) but the remaining coastal region, including the Eyre Peninsula, has only 400–500 mm (16–20 inches) or very much less and the interior is virtually desert. Pickford (1937) in a very thorough survey of the earthworm fauna of South Africa found no earthworms where the rainfall was less than 25 inches and the wetter parts of South Australia are near, often below, this limit. The rainfall in coastal Victoria, in contrast, varies from 500–750 mm (20–30 inches) in the drier west to 750–1975 mm (30–80 inches) in the east while Tasmania

also has areas ranging from 500–2000 mm but is generally wetter than Victoria.

Of the regions in South Australia not investigated for earthworms, only the Yorke Peninsula appears to be wet enough to yield earthworms and though some additional species doubtless remain to be discovered in the areas from which they have been collected, it is unlikely that further collecting will elevate the South Australian fauna above a total of about twenty species.

It is noteworthy that the great majority of South Australian species, all in *Gemascolex* and *Spenceriella*, have caudal enteronephry, a condition which would appear to be an adaptation for water conservation as urine excreted into the intestine is presumably concentrated by resorption of water in the hind gut. The close similarity of the species within *Gemascolex*, as in *Spenceriella*, suggests relatively recent speciation from an even smaller fauna.

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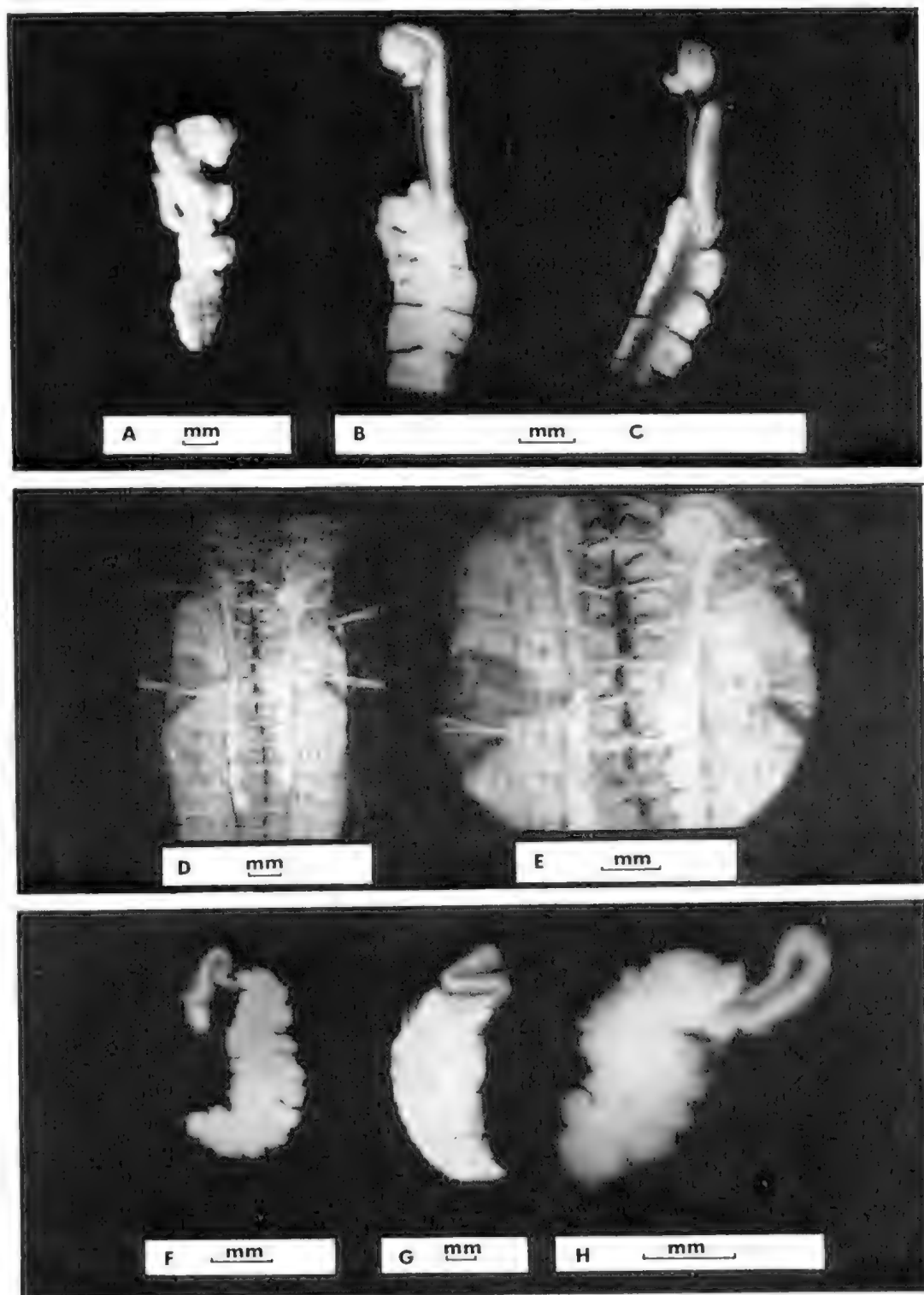


Fig. 11. Prostatae of: *A*, *Heteroporodrilus shephardi armatus*, paratype 3, Lk4. *B-E*, *Gemascolex bursatus*, holotype, Jj3; *B*, dorsal; *C*, ventral; *D* & *E*, prostatae in situ, showing bursae, muscular ducts, and glands adherent to the intestine. *F*, *Gemascolex lateralis*, specimen 3, Ll1. *G*, *Gemascolex stirlingi*, specimen 1, Jg1. *H*, *Gemascolex walkeri*, holotype, Jj1. Scale 1 mm.

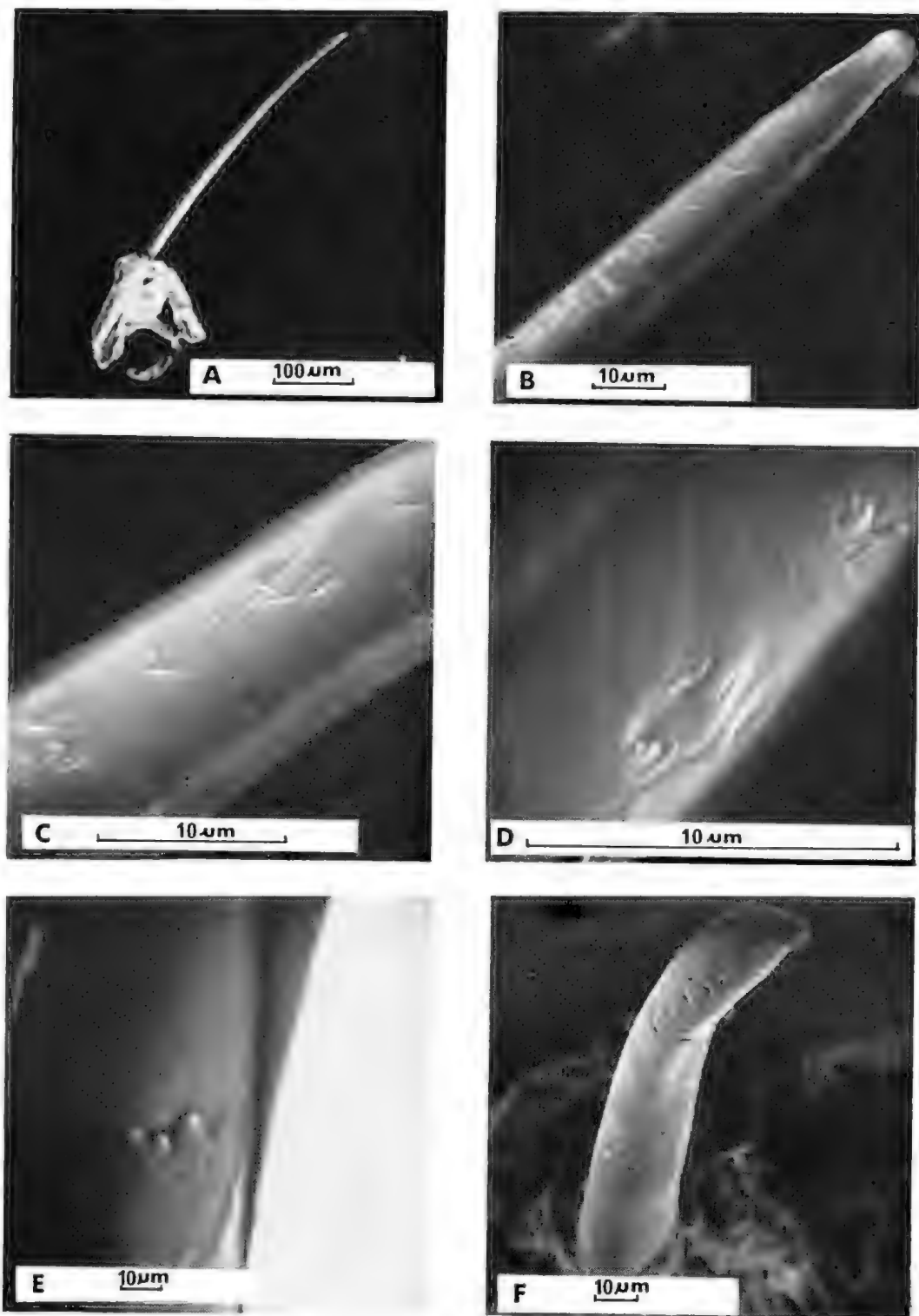


Fig. 12. Penial setae of *Microscolex dubius*, by scanning electron microscope. *A*, entire seta with muscle adherent basally; *B*, tip of same seta; *C*, *D*, *E*, sculpturing of same; *F*, seta of second specimen, L14.

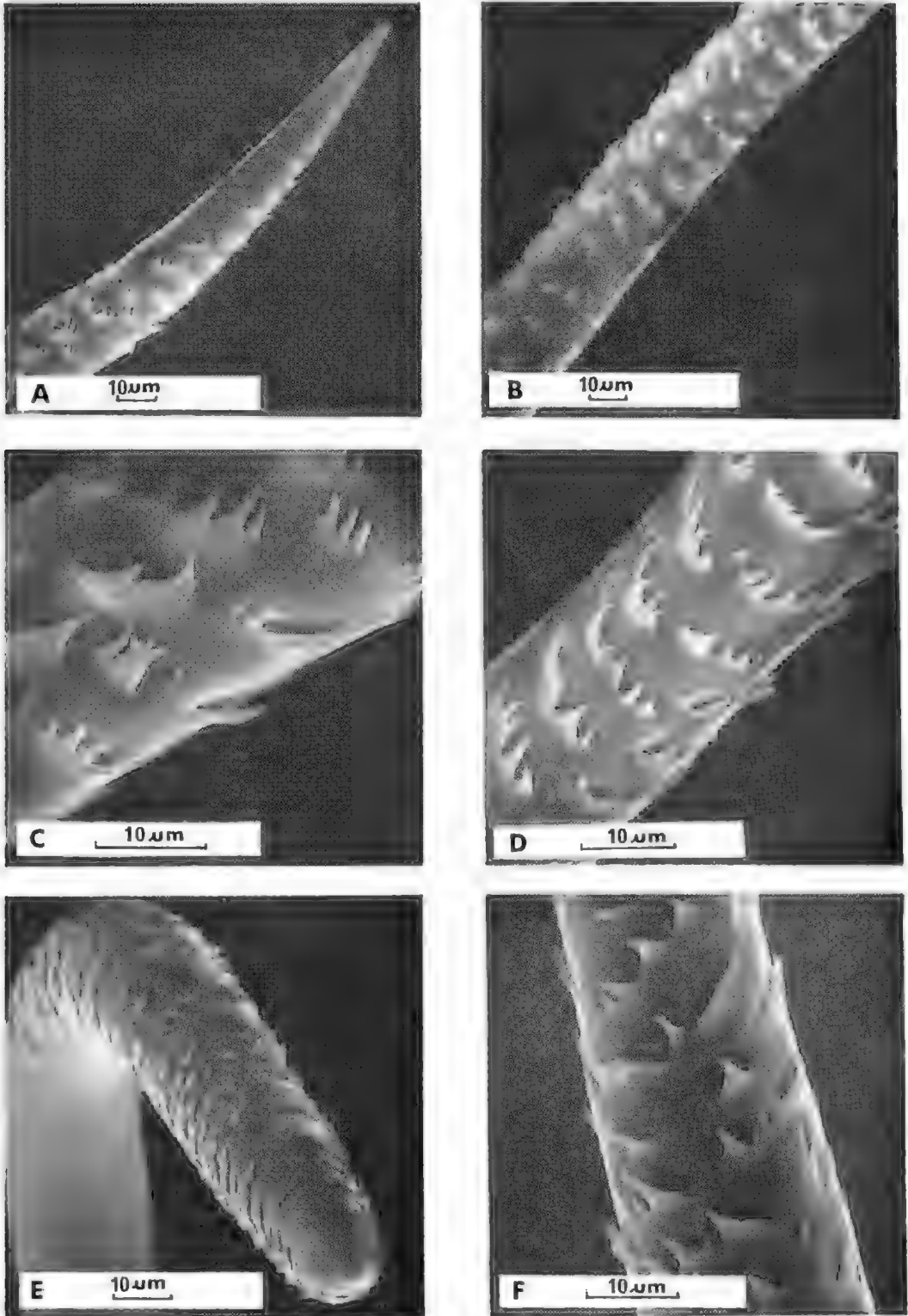


Fig. 13. Penial setae of *Heteroporodrilus shephardi armatus*, by scanning electron microscope. *A-D*, holotype, L11; *A*, tip of seta; *B* & *C*, sculpturing; *D*, sculpturing of second seta; *E* & *F*, paratype 1, Lk4; *E*, tip; *F*, sculpturing.